Invertek Drives.com

Engineering Guide

Compact 2-Basic E3

AC Variable Speed Drive
0.37 – 4.0kW (0.5 – 5HP)
230V-480V

Declaration of Conformity

Invertek Drives Ltd hereby states that the Optidrive Compact 2 product range conforms to the relevant safety provisions of the following council directives:

2014/30/EU (EMC) and 2014/35/EU (LVD)

Designed and manufacture is in accordance with the following harmonised European standards:

EN 61800-5-1: 2007	Adjustable speed electrical power drive systems. Safety requirements. Electrical, thermal and energy.
EN 61800-3: 2004 /A1 2012	Adjustable speed electrical power drive systems. EMC requirements and specific test methods
EN 55011: 2007	Limits and Methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment (EMC)

Electromagnetic Compatibility

All Optidrives are designed with high standards of EMC in mind. All versions suitable for operation on Single Phase 230 volt and Three Phase 400 volt supplies and intended for use within the European Union are fitted with an internal EMC filter. This EMC filter is designed to reduce the conducted emissions back into the mains supply via the power cables for compliance with the above harmonised European standards. It is the responsibility of the installer to ensure that the equipment or system into which the product is incorporated complies with the EMC legislation of the country of use, and the relevant category. Within the European Union, equipment into which this product is incorporated must comply with the EMC Directive 2014/30/EU. This User Guide provides guidance to ensure that the applicable standards may be achieved.

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Warranty

All Invertek Optidrive units carry a 2-year warranty against manufacturing defects from the date of manufacture. The manufacturer accepts no liability for any damage caused during or resulting from transport, receipt of delivery, installation or commissioning. The manufacturer also accepts no liability for damage or consequences resulting from inappropriate, negligent or incorrect installation, incorrect adjustment of the operating parameters of the drive, incorrect matching of the drive to the motor, incorrect installation, unacceptable dust, moisture, corrosive substances, excessive vibration or ambient temperatures outside of the design specification.

The local distributor may offer different terms and conditions at their discretion, and in all cases concerning warranty, the local distributor should be contacted first.

Do not attempt to carry out any repair of the Compact 2. In the case of suspected fault or malfunction, contact your local Invertek Drives Sales Partner for further assistance.

This user guide is the "original instructions" document. All non-English versions are translations of the "original instructions".

The contents of this User Guide are believed to be correct at the time of printing. In the interest of a commitment to a policy of continuous improvement, the manufacturer reserves the right to change the specification of the product or its performance or the contents of the User Guide without notice.

Engineering Guide Issue 08 (02/19)

Invertek Drives Ltd adopts a policy of continuous improvement and whilst every effort has been made to provide accurate and up to date information, the information contained in this User Guide should be used for guidance purposes only and does not form the part of any contract.

1. About this Advanced Technical Manual

1.1. Compatibility

This Document is for use with version 2.05 Firmware.

Invertek Drives Ltd adopts a policy of continuous improvement and whilst every effort has been made to provide accurate and up to date information, the information contained in this User Guide should be used for guidance purposes only and does not form the part of any contract.

The information in this user guide relates to the functionality of the firmware version as stated above. Prior versions of firmware may not fully support all functions as described. If necessary, firmware updates may be carried out using Optitools Studio PC software.

1.2. Intended Audience

The Optidrive Compact 2 product range is intended for machine builders to allow direct integration into a machine design or system. As such, this Advanced Technical Manual provides the necessary technical information to allow competent users to correctly select the required model and install and commission in a safe manner that maintains the drive within its operating parameters.

2. Important Safety Information

Please read the IMPORTANT SAFETY INFORMATION below, and all Warning and Caution information elsewhere.

2.1. Symbols Used Throughout this Document

	**Electricity Warning: Indicates a risk of electric shock, which, if not avoided, could result in damage to equipment and possible injury or death.**
	**General Warning: Indicates a potentially hazardous situation other than electrical, which if not avoided, could result in damage to equipment and possible injury or death.**

2.2. Important Safety Information

	**This manual is intended as a guide for proper installation. Invertek Drives Ltd cannot assume responsibility for the compliance or the non-compliance to any code, national, local or otherwise, for the proper installation of this drive or associated equipment. A hazard of personal injury and/or equipment damage exists if codes are ignored during installation.**
	**This Optidrive contains high voltage capacitors that take time to discharge after removal of the main supply. Before working on the drive, ensure isolation of the main supply from line inputs. Wait ten (10) minutes for the capacitors to discharge to safe voltage levels. Failure to observe this precaution could result in severe bodily injury, loss of life and damage to equipment.**
	**Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this manual and other applicable manuals in their entirety before proceeding.**

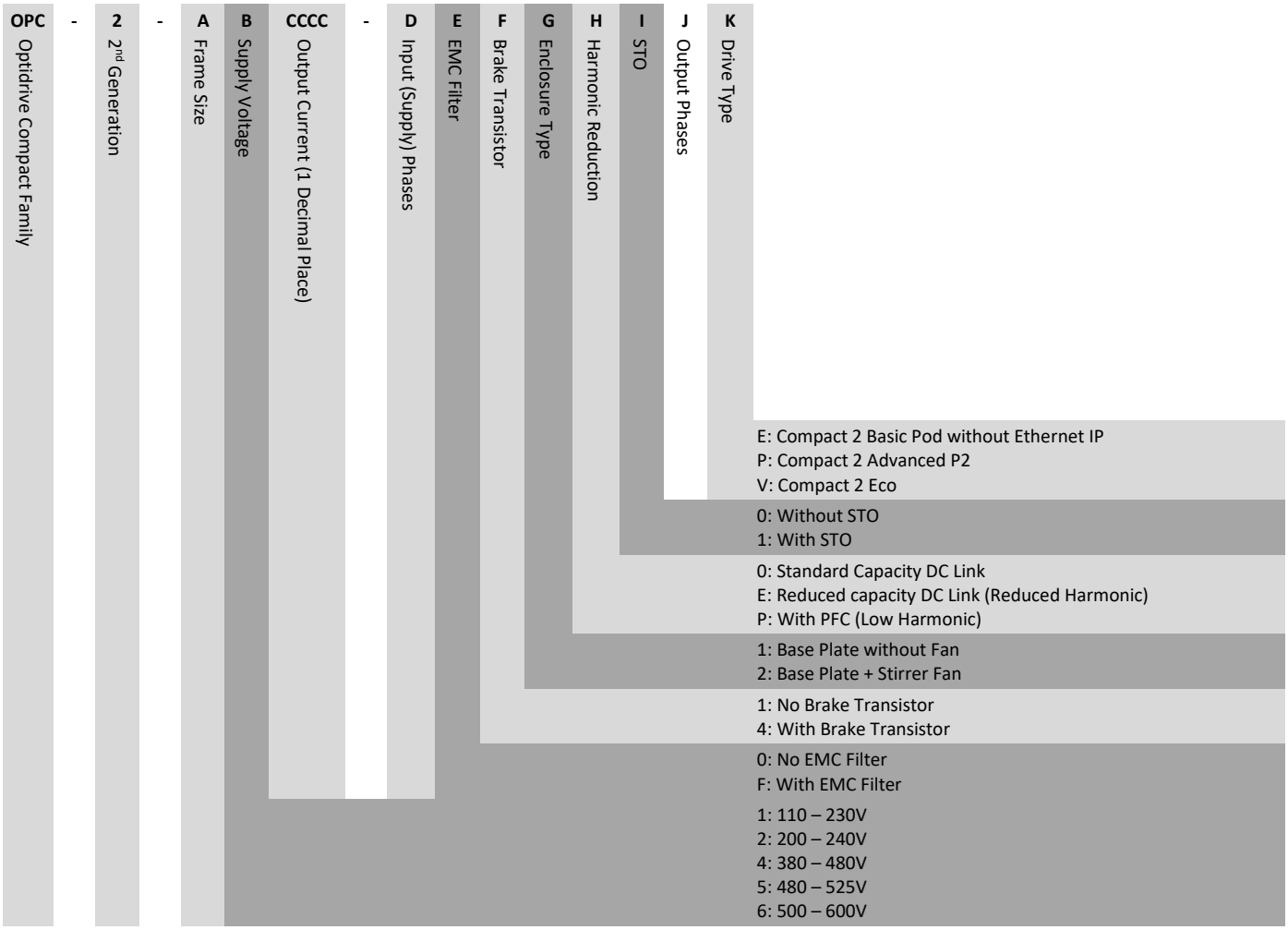
	The Compact 2 variable speed drive product is intended for professional incorporation into complete equipment or systems as part of a fixed installation. If installed incorrectly it may present a safety hazard. The drive uses high voltages and currents, carries a high level of stored electrical energy, and is used to control mechanical plant that may cause injury. Close attention is required to system design and electrical installation to avoid hazards in either normal operation or in the event of equipment malfunction. Only qualified electricians are allowed to install and maintain this product.
	System design, installation, commissioning and maintenance must be carried out only by personnel who have the necessary training and experience. They must carefully read this safety information and the instructions in this Guide and follow all information regarding transport, storage, installation and use of the drive, including the specified environmental limitations.
	Suitably rated fuses or MCB should be fitted in the mains supply to the drive, according to any local legislation or codes.
	For drives with an internal EMC filter fitted, do not perform any flash test or voltage withstand test on the drive unless the filter is first disconnected as described later in this document.
	Electric shock hazard! Disconnect and ISOLATE the drive before attempting any work on it. High voltages are present at the terminals and within the drive for up to 10 minutes after disconnection of the electrical supply. Always ensure by using a suitable multimeter that no voltage is present on any drive power terminals prior to commencing any work.
	Where supply to the drive is through a plug and socket connector, do not disconnect until 10 minutes have elapsed after turning off the supply.
	Ensure correct earthing connections. The earth cable must be sufficient to carry the maximum supply fault current which normally will be limited by the fuses or MCB. Suitably rated fuses or MCB should be fitted in the mains supply to the drive, according to any local legislation or codes.
	Touch leakage current from the drive may exceed 3.5mA.
	Do not carry out any work on the drive control cables whilst power is applied to the drive or to the external control circuits.
	The STOP function does not remove potentially lethal high voltages. ISOLATE the drive and wait 10 minutes before starting any work on it. Never carry out any work on the Drive, Motor or Motor cable whilst the input power is still applied.
	Ensure that the supply voltage, frequency and no. of phases (1 or 3 phase) correspond to the rating of the Compact 2 as delivered.
	Within the European Union, all machinery in which this product is used must comply with Directive 2006/42/EC, Safety of Machinery. In particular, the machine manufacturer is responsible for providing a main switch and ensuring the electrical equipment complies with EN60204-1.
	The level of integrity offered by the Compact 2 control input functions – for example stop/start, forward/reverse and maximum speed is not sufficient for use in safety-critical applications without independent channels of protection. All applications where malfunction could cause injury or loss of life must be subject to a risk assessment and further protection provided where needed.
	The driven motor can start at power up if the enable input signal is present. Do not activate the automatic fault reset function on any systems whereby this may cause a potentially dangerous situation.
	The drive can be programmed to operate the driven motor at speeds above or below the speed achieved when connecting the motor directly to the mains supply. Obtain confirmation from the manufacturers of the motor and the driven machine about suitability for operation over the intended speed range prior to machine start up.
	Do not activate the automatic fault reset function on any systems whereby this may cause a potentially dangerous situation.
	The Compact 2 is intended for indoor use only.
	When mounting the drive, ensure that sufficient cooling is provided. Do not carry out drilling operations with the drive in place, dust and swarf from drilling may lead to damage.
	The entry of conductive or flammable foreign bodies should be prevented. Flammable material should not be placed close to the drive
	Never connect the mains power supply to the Output terminals U, V, W.
	Beware of hot surfaces. Some surfaces may become hot during normal operation of the drive and may remain hot even after disconnection of the electrical supply.

3. Product Overview

3.1. General Information

The Optidrive Compact 2 family is a dedicated range of products intended for integration directly into a machine design. All units consist of a base Power Module (PM) and Control Module (CM) which, when combined together become a complete drive unit. This construction method provides enhanced flexibility.
In addition, an optional fieldbus interface may be added, allowing direct connection to fieldbus networks.
Power Modules feature a flat base surface, intended to be mounted to a suitable heat conductive surface which can provide heatsink capability. The required cooling must be catered for by the installation.
Control modules feature an interface to allow connection of a remote keypad / display for commissioning purposes, or alternatively a PC interface may be used.
Please not that there are alternative versions of Compact 2 (Basic, Eco, Advanced) which have separate documentation. Please ensure you refer to the correct User Guide for required information.

3.2. Model Code Definition



Note: The definition above covers the complete Compact 2 family. Not all combinations of features are possible or described in this guide. For information regarding availability of models, please contact Invertek Drives.

3.3. Available Models

3.3.1. Standard Units

110 – 115 + 10% / - 10%, 1 Phase Input, 3 Phase 230V Output (Voltage Doubler)								
Output Voltage	**Output Phases**	**Output Current**	**kW**	**HP**	**Frame Size**	**Brake Transistor**	**Model Code - Filtered**	**Model Code - Unfiltered**
230	3	2.3A	0.37	0.5	1A	No	OPC-2-110023-1F11003E	OPC-2-110023-1011003E
230	3	3.2A	0.55	0.75	1B	No	OPC-2-110032-1F12003E	OPC-2-110032-1012003E
200 – 240 + 10% / - 10%, 1 Phase Input, 3 Phase Output								
Output Voltage	**Output Phases**	**Output Current**	**kW**	**HP**	**Frame Size**	**Brake Transistor**	**Model Code - Filtered**	**Model Code - Unfiltered**
230	3	2.3A	0.37	0.5	1A	No	OPC-2-120023-1F11003E	OPC-2-120023-1011003E
230	3	4.3A	0.75	1	1A	No	OPC-2-120043-1F11003E	OPC-2-120043-1011003E
230	3	7.0A	1.5	2	1B	No	OPC-2-120070-1F12003E	OPC-2-120070-1012003E
200 – 240 + 10% / - 10%, 3 Phase Input, 3 Phase Output								
Output Voltage	**Output Phases**	**Output Current**	**kW**	**HP**	**Frame Size**	**Brake Transistor**	**Model Code - Filtered**	**Model Code - Unfiltered**
230	3	2.3A	0.37	0.5	1A	No	OPC-2-120023-3F11003E	OPC-2-120023-3011003E
230	3	4.3A	0.75	1	1A	No	OPC-2-120043-3F11003E	OPC-2-120043-3011003E
230	3	7.0A	1.5	2	1B	No	OPC-2-120070-3F12003E	OPC-2-120070-3012003E
380 – 480 + 10% / - 10%, 3 Phase Input, 3 Phase Output								
Output Voltage	**Output Phases**	**Output Current**	**kW**	**HP**	**Frame Size**	**Brake Transistor**	**Model Code - Filtered**	**Model Code - Unfiltered**
400 / 460	3	2.2A	0.37	0.5	1A	No	OPC-2-140022-3F11003E	OPC-2-140022-3011003E
400 / 460	3	4.1A	0.75	1	1B	No	OPC-2-140041-3F12003E	OPC-2-140041-3012003E
400 / 460	3	5.8A	2.2	3	2	Yes	OPC-2-240058-3F42003E	OPC-2-240058-3042003E
400 / 460	3	9.5A	4	5	2	Yes	OPC-2-240095-3F42003E	OPC-2-240095-3042003E

Note: Models which do not have an internal stirrer fan fitted as standard (Frame Size 1A) are optionally available with a stirrer fan if this is required by the application to maintain the temperatures within acceptable limits. In this case, the dimensions including the fan are as Frame Size 1B.

3.3.2. Active PFC Units

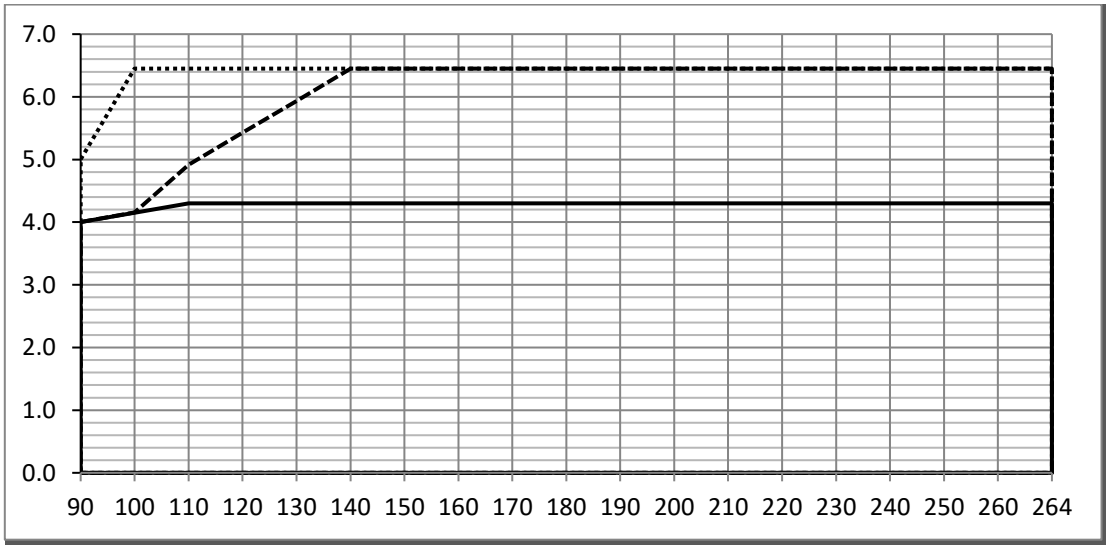
110 – 230 + 10% / - 20%, 1 Phase Input, 3 Phase 230V Output								
Output Voltage	**Output Phases**	**Output Current**	**kW**	**HP**	**Frame Size**	**Brake**	**EMC Filter**	**Model Code**
230	3	4.3A	0.75	1	1C	No	Yes	OPC-2-110043-1F11P03E
200 – 240 + 10% / - 10%, 1 Phase Input, 3 Phase Output								
Output Voltage	**Output Phases**	**Output Current**	**kW**	**HP**	**Frame Size**	**Brake**	**EMC Filter**	**Model Code**
230	3	7.0A	1.5	2	1C	No	Yes	OPC-2-120070-1F11P03E

3.4. Power Module Output Current Capacity

3.4.1. Output Current Capacity Relative to Supply Voltage

OPC-2-110043-1F11P03#

This unit can operate with a supply voltage range from 90 – 264VAC.
When the supply voltage is below 110 Volt, continuous output current capacity and available overload current are reduced as shown below.



Continuous Output Current Capacity	———
Permissible Overload at 40Hz Output Frequency for 60 Seconds	– – – – – – – –
Permissible Overload at 50Hz Output Frequency for 60 Seconds	.....

3.5. Overload Current Capacity

The table below shows the continuously available output current and additionally overload and peak current capacity.

Supply Voltage	Supply Phases	Output Voltage	kW	HP	Continuous Current (A)	Overload Current (60s)	Peak Current (2s)	Frame Size	Model Code OPC-2-…
115	1	230	0.37	0.5	2.3A	3.45A	4.0A	1A	110023-1#1#003E
115	1	230	0.55	0.75	3.2A	4.8A	5.6A	1B	110032-1#1#003E
115	1	230	0.75	1	4.3A	6.45A	7.5A	1C	110043-1#1#P03E
230	1	230	0.37	0.5	2.3A	3.45A	4.0A	1A	120023-1#1#003E
230	1	230	0.75	1	4.3A	6.45A	7.5A	1A	120043-1#1#003E
230	1	230	1.5	2	7.0A	7.88A	10.5A*	1B	120070-1#1#003E
230	1	230	1.5	2	7.0A	10.5A	12.2A	1C	120070-1#1#P03E
230	3	230	0.37	0.5	2.3A	3.45A	4.0A	1A	120023-3#1#003E
230	3	230	0.75	1	4.3A	6.45A	7.5A	1A	120043-3#1#003E
230	3	230	1.5	2	7.0A	7.88A	10.5A*	1B	120070-3#1#003E
400	3	400 / 460	0.37	0.5	2.2A	3.3A	3.85A	1	140022-3#1#003E
400	3	400 / 460	0.75	1	4.1A	6.15A	7.1A	1	140041-3#1#003E
400	3	400 / 460	2.2	3	5.8A	7.7A	10.1A	2	240058-3#4#003E
400	3	400 / 460	4	5	9.5A	14.25A	16.6A	2	240095-3#4#003E

Note: *Peak current available when heatsink temperature <60C. Above 60C, peak available current is reduced to 8.4A.

3.6. Output Current Limit

3.6.1. Overload Operation

Optidrive Compact 2 provides the following maximum permissible overload current: -

- All units except Frame 1B 7A rating
  - 150% Output current / 60 Seconds Maximum
  - 175% Output current / 2.5 Seconds Maximum
- 1B 7A rating
  - 112.5% Output current / 60 Seconds Maximum
  - 150% Output current / 2.5 Seconds Maximum when heatsink temperature<60°C
  - 120% Output current / 2.5 Seconds when heatsink temperature >=60°C

In addition, maximum continuous output current available and maximum permissible overload time may be adjusted according to the following:

- PWM Switching Frequency Selected
- Low Output Frequency
- High Ambient Temperature

These functions are described more fully below.

3.6.2. Overview

Optidrive Compact 2 features both hardware and software protection of the output stage to prevent damage. In addition, an Ixt function is used to monitor motor overload condition and prevent damage to the motor due to operation for prolonged periods at high load.
I x t protection is software based, using the value for motor rated current programmed in P-08. An internal accumulator register is used to estimate the point at which damage may occur to the motor, and operates as follows:

Motor Current < P-08

The accumulator value reduces towards zero. The time required depends on the actual load current as explained further below.

Motor Current = 100% P-08

The accumulator value remains static.

Motor Current > 100% P-08 < 150% P-08

The accumulator value increases at a rate proportional to the overload level, e.g. (Motor Current / Rated current) – 100%. If the overload limit is reached, the drive will trip, displaying it.trp. to protect the motor.

Motor Current > 150% P-08

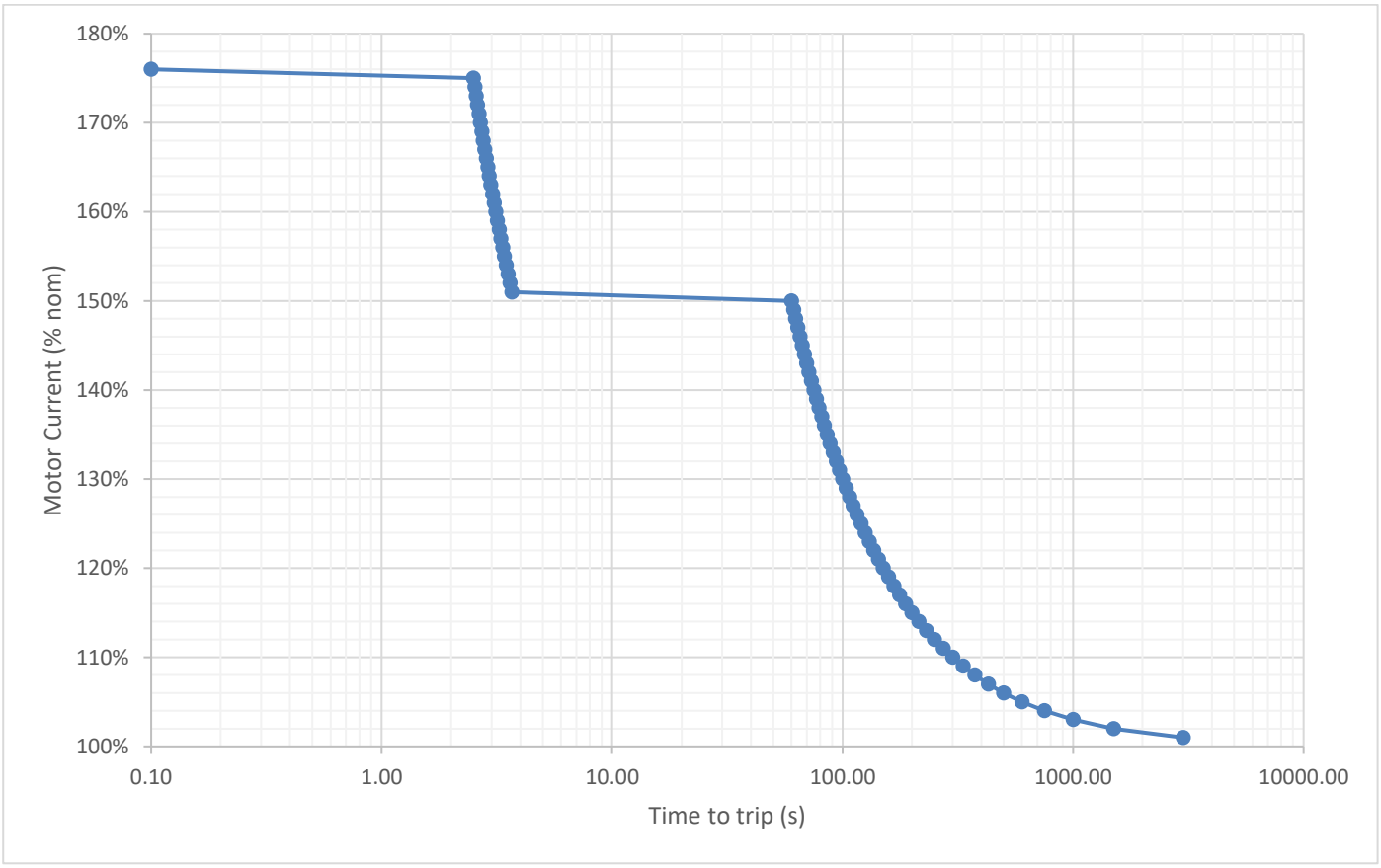
For high current levels, the accumulator operates 16 times faster than for current levels below 150% of P-08.
Peak over current trip levels are shown in the table below.

3.6.3. Example Operation

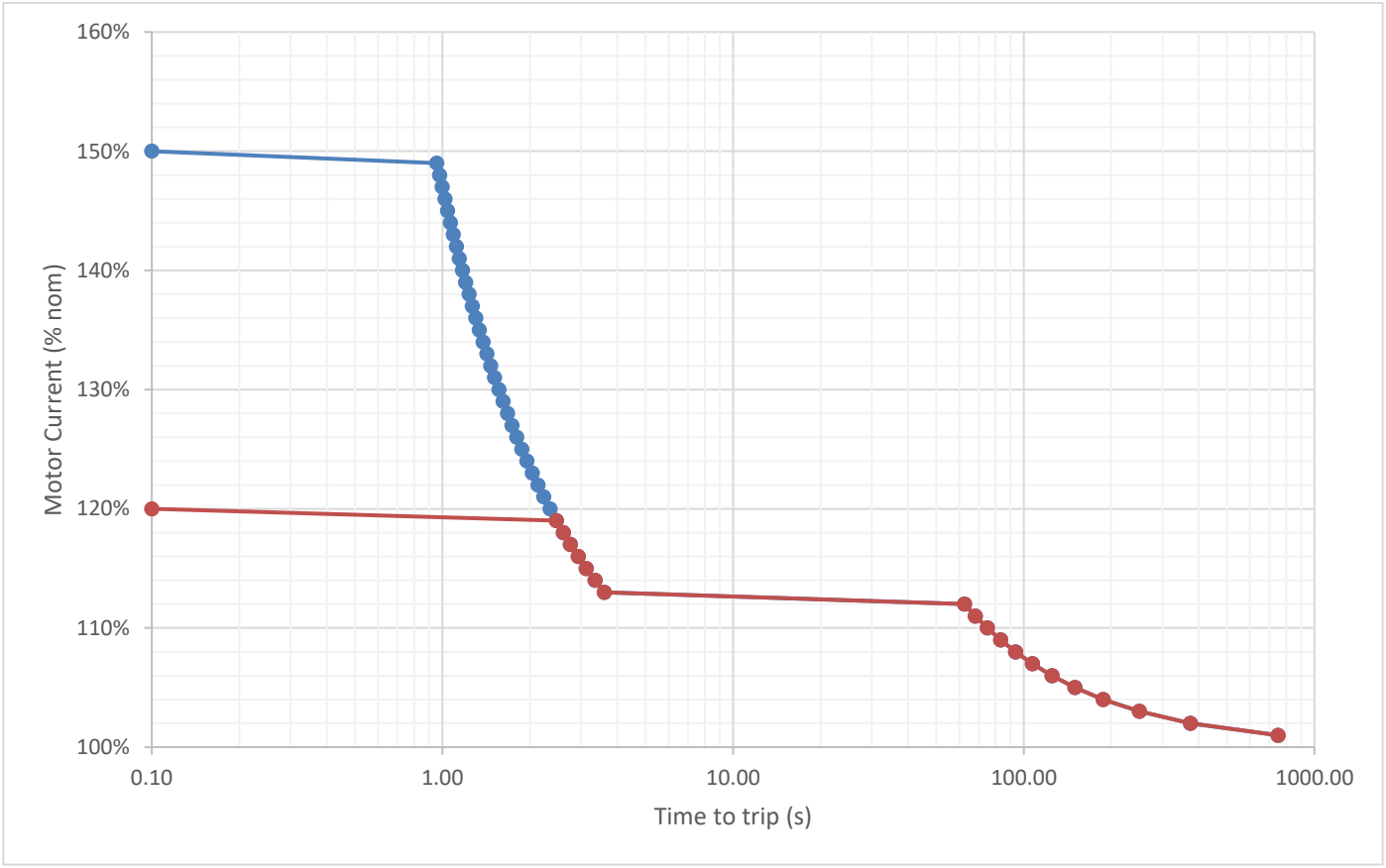
Based on the maximum overload operation of 150% (note use 112.5% for 7A Frame 1B) of motor rated current for 60 seconds. T
his represents an overload of 50% above the nominal 1005 load capacity therefore the maximum accumulator value before trip is
50% x 60s = 3000
This means that if the drive operates with 125% load current, the time can be calculated as 3000 / (125 – 100) = 120 Seconds.
Above 150% load, accumulation is 16 times faster, hence for 160% load current, the time is 3000 / 16 / (160 – 100) = 3.125 seconds

3.6.4. Allowed Overload vs Time

All units except Frame 1B 7.0A rating:



Frame 1B 7.0A Rating



Allowed overload when heatsink temperature <60C
Allowed Overload when heatsink temperature >=60C

4. Mechanical Information and Mounting

4.1. General

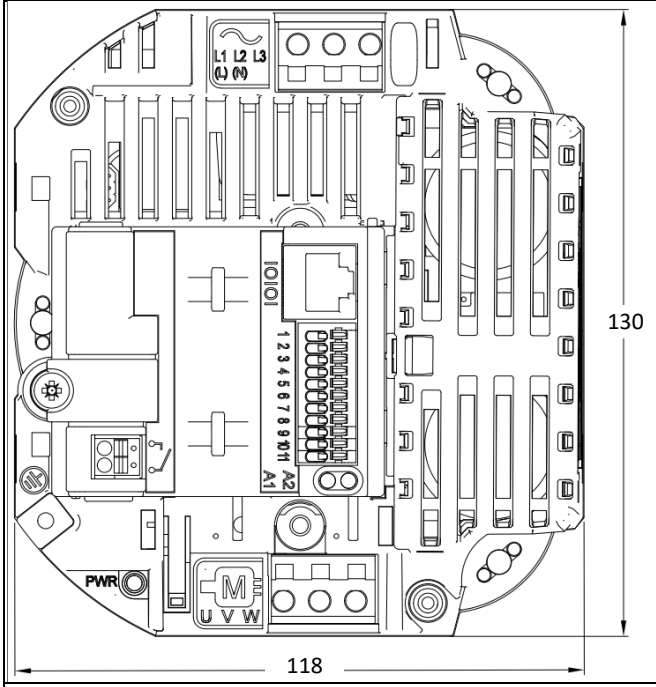
Compact 2 units may become damaged if operated without a suitable heatsink. Do not operate the unit without providing suitable heatsink capacity for the drive and application requirement.

- Compact 2 Power Modules must be mounted onto a suitable flat metallic surface with sufficiently low thermal resistance to allow dissipation of the heat produced.
- Surface flatness must be =<+ / - 0.2mm over the mounting area.
- The chosen mounting location must ensure the unit is not subject to vibration levels in excess of the limits specified in section 11.4.1.
- Units should be mounted only using the integral mounting holes.
- The Compact 2 must be installed in a pollution degree 1 or 2 environment only.
- Ensure that the ambient air temperature range around the unit during operation does not exceed the permissible limits given in section 11.1.
- Do not mount flammable material close to the Compact 2.
- Units may be mounted in any orientation.

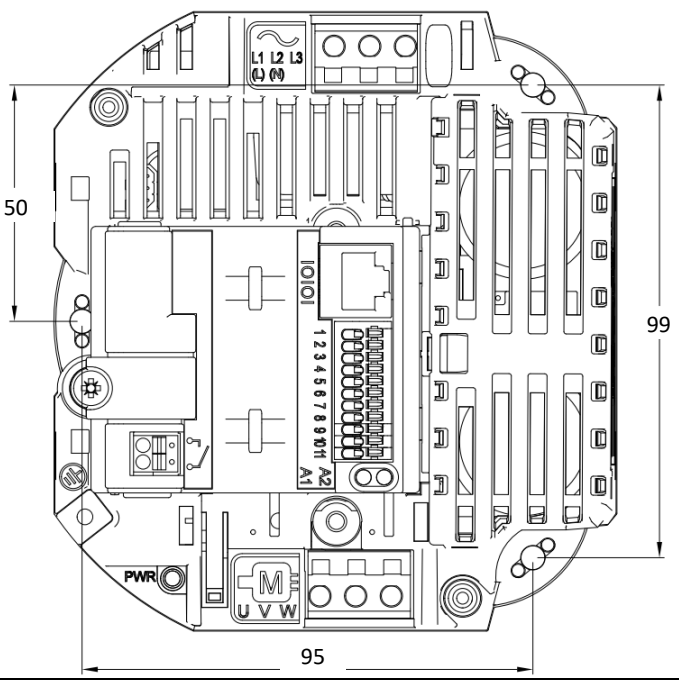
4.2. Mechanical Dimensions and Mounting

4.2.1. Frame Size 1A & 1B – Non-PFC Drives

Overall Dimensions



Mounting Points

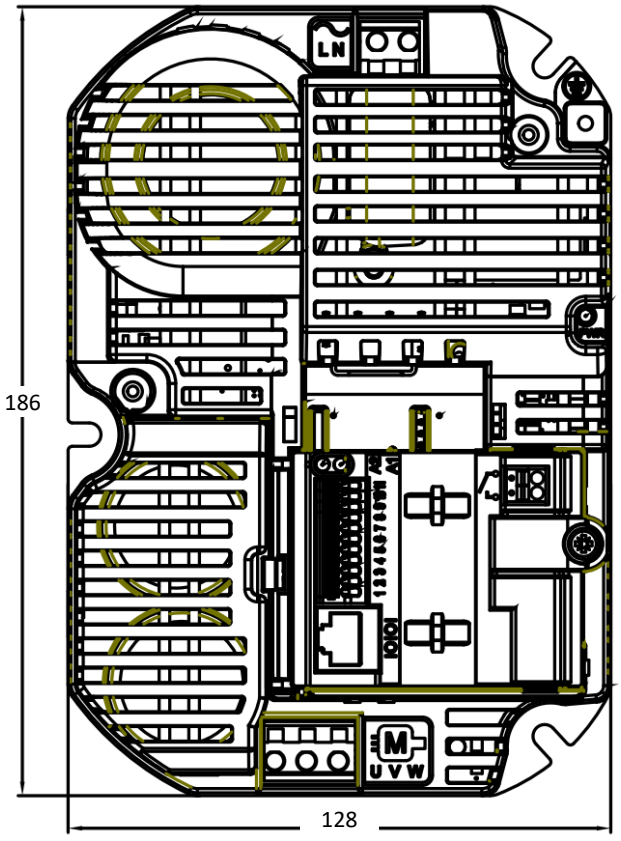
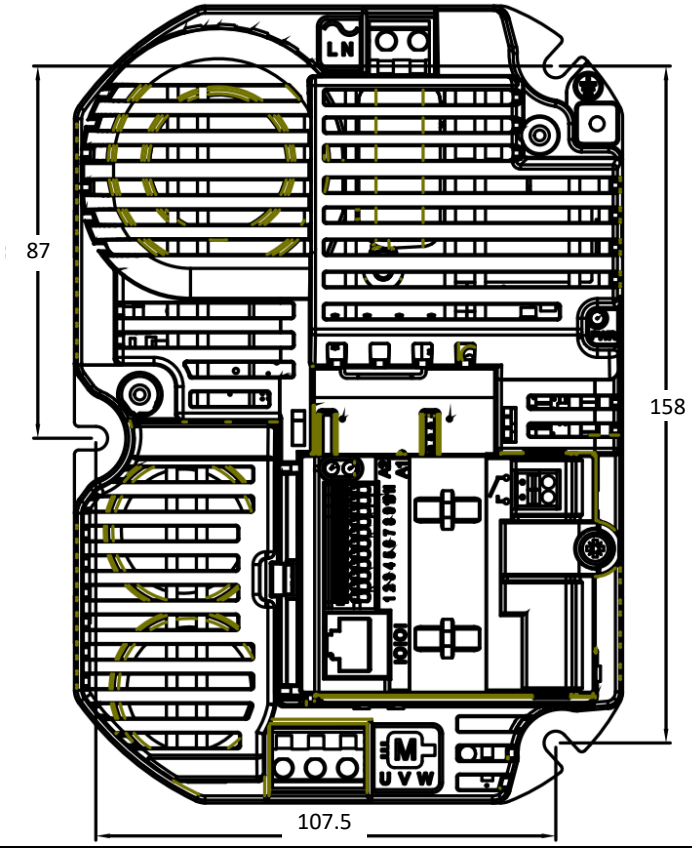


Depth: Frame Size 1A: 74mm, Frame Size 1B: 85mm

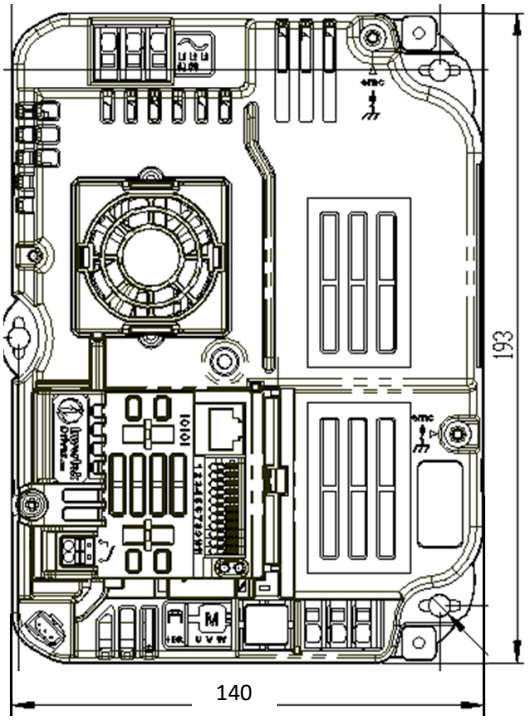
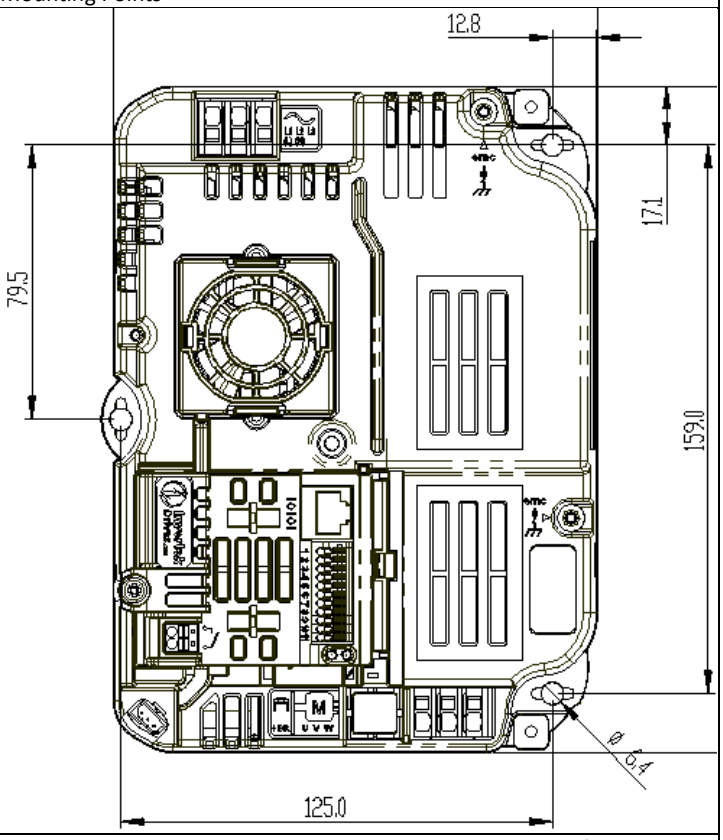
Use 3 x M4 (No. 8) bolts or screws, tightening torque: 4Nm / 3ft-lb

Weight	0.7kg, 1.54lb
Note	Frame Size 1 is available in version 1A without cooling fan or version 1B with internal cooling fan. Testing is required for each possible application to determine which version may be used.

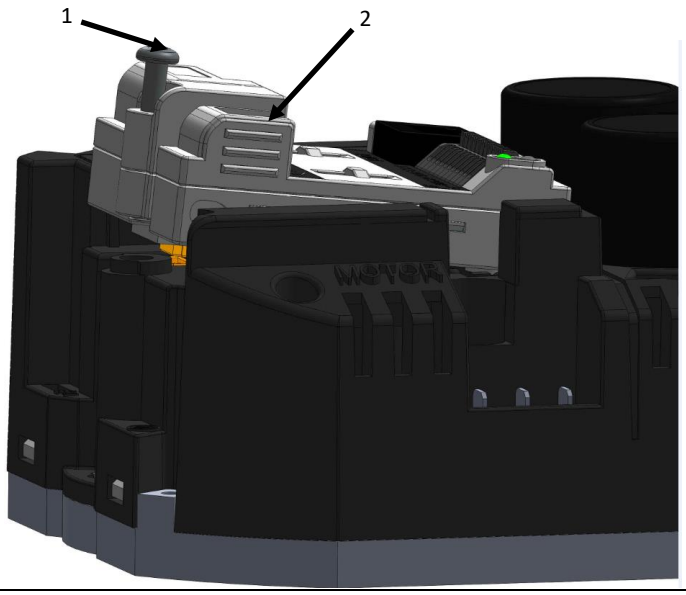
4.2.2. Frame Size 1C –PFC Drives

Overall Dimensions	Mounting Points
	
Depth: 81mm	Use 3 x M4 (No. 8) bolts or screws, tightening torque: 4Nm / 3ft-lb
Weight 0.7kg, 1.54lb	

4.2.3. Frame Size 2

Overall Dimensions	Mounting Points
	
Depth: 89mm	Use 3 x M4 (No. 8) bolts or screws, tightening torque: 4Nm / 3ft-lb
Weight	

4.3. Removing/Changing the Control Module.

Control Module removal.
1. Fully unscrew the cross-head screw. 2. Press finger grips and Lift the Control module from the screw side. 3. Rotate towards the control terminal side as shown.


Note:

- **Do not remove or refit the Control Module whilst mains power is applied to the base**.
- After removing power, wait a minimum of five minutes before attempting to remove or refit the pod
- Failure to follow this instruction can result in damage to the unit

4.4. Heatsink Capacity Calculation

Optidrive Compact 2 Units are designed to be mounted to a metallic, heat conducting surface in order to maintain the unit operating temperature. Thermostrate or heatsink compound must be added to ensure optimal heat transfer and minimum thermal resistance.
In order to calculate the necessary heatsink requirement, the following formula can be used. Example values based on typical conditions are given in the table below.

- Determine the maximum ambient air temperature around the heatsink, T_{AMB}
- Select the desired PWM operating frequency from the available options in Parameter P-17
- From the table below, determine the maximum permissible heatsink temperature, T_{MAX}
- Determine the maximum allowed Temperature Rise
  - $T_{RISE} = T_{MAX} - T_{AMB}$
- Calculate the motor absorbed electrical power, P_{MOT}, based on the motor rated voltage, current and efficiency
  - $P_{MOT} = \sqrt{3} * \text{Rated Voltage} * \text{Rated Current} * \text{Power Factor} * \text{Efficiency}$
- Calculate the losses in the drive, P_{LOSS}, based on the required motor power
  - $P_{LOSS} = P_{MOT} * (1 - \text{Drive Efficiency})$
  - Typical drive efficiency values are shown in the table below for each available effective switching frequency
- Calculate the required heatsink maximum thermal resistance R_{MAX}
  - $R_{MAX} = T_{RISE} / P_{LOSS}$

4.5. Maximum Permissible Heatsink Temperature

The maximum permissible heatsink temperature allowed for the Compact 2 drive is linked to the desired effective switching frequency selected by parameter P-17. In order to maintain operation at a certain switching frequency, the heatsink temperature must be maintained below the threshold level shown in the table below. If the temperature exceeds the threshold, the switching frequency will automatically reduce.

Temperature Threshold	Action
65 ^{O}C	Auto reduce from 32kHz to 24kHz
70 ^{O}C	Auto reduce from 24kHz to 16kHz
80 ^{O}C	Auto reduce from 16kHz to 12kHz
85 ^{O}C	Auto reduce from 12kHz to 8kHz
94 ^{O}C	Over temperature trip if P-17 >= 8kHz
97 ^{O}C	Over temperature trip if P-17 < 8kHz

Note:

- Switching frequency may be automatically reduced under certain operating conditions, refer to section 11.8 on page 53 Automatic Switching Frequency Reduction for further information.
- **For Frame Size 1B 7.0A rated units, over-temperature trip occurs at 80°C**

4.6. Typical Heatsink Requirement

The table below provides typical values for heatsink thermal resistance.

4.6.1. Single Phase Input 110 – 115VAC Supply Models

Base Unit Model Code	Effective Switching Frequency (KHz)	Typical Rated Output Power (W)	Approximate Efficiency	Maximum Heatsink Temperature (°C)	Recommended Maximum Heatsink Thermal Resistance (K/W)
OPC-2-110023-1#11003E	4	370	96.6%	95	2.4
	8	370	96.2%	90	1.9
	12	370	97.5%	85	2.6
	16	370	97.5%	80	2.2
	24	370	96.2%	75	1.2
	32	370	95.4%	70	0.8
Standby Power Loss: 5 Watts					
OPC-2-110032-1#11003E	4	550	96.6%	95	1.7
	8	550	96.2%	90	1.3
	12	550	97.5%	85	1.8
	16	550	97.5%	80	1.5
	24	550	96.2%	75	0.9
	32	550	95.4%	70	0.6
Standby Power Loss: 5 Watts					

4.6.2. Single Phase Input 200 – 240VAC Supply Models

Base Unit Model Code	Effective Switching Frequency (KHz)	Typical Rated Output Power (W)	Approximate Efficiency	Maximum Heatsink Temperature (°C)	Recommended Maximum Heatsink Thermal Resistance (K/W)
OPC-2-120023-1#11003E	4	370	96.0%	95	2.5
	8	370	95.9%	90	2.2
	12	370	95.9%	85	1.9
	16	370	95.7%	80	1.6
	24	370	95.7%	75	1.3
	32	370	95.6%	70	1.0
Standby Power Loss: 5 Watts					
OPC-2-120043-1#11003E	4	750	96.0%	95	1.2
	8	750	95.9%	90	1.0
	12	750	95.9%	85	0.9
	16	750	95.7%	80	0.7
	24	750	95.7%	75	0.6
	32	750	95.6%	70	0.5
Standby Power Loss: 5 Watts					
OPC-2-120070-1#11003E	4	1500	94.6%	80	0.30
	8	1500	94.4%	80	0.29
	12	1500	94.2%	80	0.28
	16	1500	94.0%	80	0.27
	24	1500	93.7%	75	0.21
	32	1500	93.6%	70	0.17
Standby Power Loss: 5 Watts					

4.6.3. Three Phase Input 200 – 240VAC Supply Models

Base Unit Model Code	Effective Switching Frequency (KHz)	Typical Rated Output Power (W)	Approximate Efficiency	Maximum Heatsink Temperature (°C)	Recommended Maximum Heatsink Thermal Resistance (K/W)
OPC-2-120023-3#11003E	4	370	96.5%	95	2.1
	8	370	96.0%	90	1.7
	12	370	96.0%	85	1.4
	16	370	95.7%	80	1.2
	24	370	95.2%	75	0.9
	32	370	94.7%	70	0.6
Standby Power Loss: 5 Watts					
OPC-2-120043-3#11003E	4	750	96.1%	95	1.1
	8	750	96.0%	90	0.9
	12	750	95.8%	85	0.8
	16	750	95.6%	80	0.6
	24	750	95.2%	75	0.5
	32	750	94.7%	70	0.3
Standby Power Loss: 5 Watts					
OPC-2-120070-3#11003E	4	1500	94.6%	80	0.30
	8	1500	94.4%	80	0.29
	12	1500	94.2%	80	0.28
	16	1500	94.0%	80	0.27
	24	1500	93.7%	75	0.21
	32	1500	93.6%	70	0.17
Standby Power Loss: 5 Watts					

4.6.4. Three Phase Input 380 – 480VAC Supply Models

Base Unit Model Code	Effective Switching Frequency (KHz)	Typical Rated Output Power (W)	Approximate Efficiency	Maximum Heatsink Temperature (°C)	Recommended Maximum Heatsink Thermal Resistance (K/W)
OPC-2-140022-3#10003E	4	750	97.7%	95	2.3
	8	750	97.3%	90	1.7
	12	750	96.8%	85	1.3
	16	750	97.0%	80	1.2
	24	750	96.5%	75	0.8
	32	750	96.0%	70	0.6
Standby Power Loss: 6 Watts					
OPC-2-140041-3#10003E	4	1500	97.7%	95	1.1
	8	1500	97.3%	90	0.8
	12	1500	96.8%	85	0.6
	16	1500	97.0%	80	0.6
	24	1500	96.5%	75	0.4
	32	1500	96.0%	70	0.3
Standby Power Loss: 6 Watts					
OPC-2-240058-3#10003E	4	2200	97.6%	95	0.64
	8	2200	97.2%	90	0.49
	12	2200	96.8%	85	0.37
	16	2200	96.4%	80	0.28
	24	2200	95.4%	75	0.18
Standby Power Loss: 6 Watts					
OPC-2-240095-3#10003E	4	4000	97.3%	95	0.33
	8	4000	96.9%	90	0.26
	12	4000	96.5%	85	0.20
	16	4000	96.0%	80	0.15
	24	4000	94.9%	75	0.10
Standby Power Loss: 6 Watts					

4.6.5. Single Phase Input 110 – 230VAC Supply PFC Model

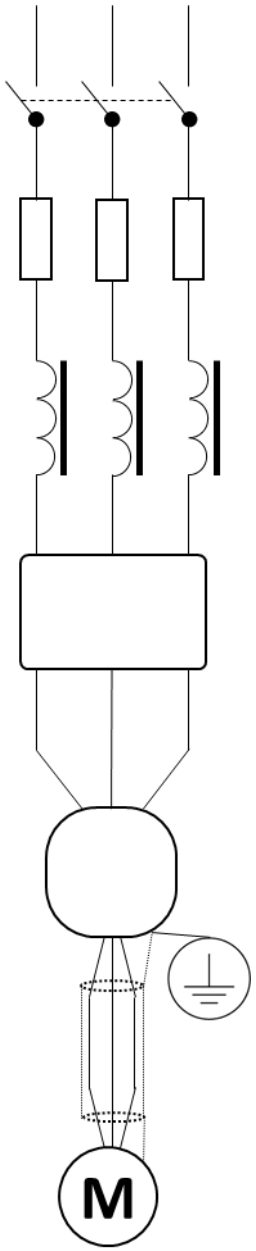
Base Unit Model Code	Effective Switching Frequency (KHz)	Typical Rated Output Power (W)	Approximate Efficiency	Maximum Heatsink Temperature (°C)	Recommended Maximum Heatsink Thermal Resistance (K/W)
OPC-2-110043-1F11P03E	4	750	95.0%	95	0.9
	8	750	94.7%	90	0.8
	12	750	94.4%	85	0.6
	16	750	94.1%	80	0.5
	24	750	93.4%	75	0.4
	32	750	92.0%	70	0.3
Standby Power Loss: 5 Watts					

4.6.6. Single Phase Input 200 – 240VAC Supply Models

Base Unit Model Code	Effective Switching Frequency (KHz)	Typical Rated Output Power (W)	Approximate Efficiency	Maximum Heatsink Temperature (°C)	Recommended Maximum Heatsink Thermal Resistance (K/W)
OPC-2-120070-1F11P03E	4	1500	95.0%	95	0.4
	8	1500	94.7%	90	0.4
	12	1500	94.4%	85	0.3
	16	1500	94.1%	80	0.2
	24	1500	93.4%	75	0.2
	32	1500	92.0%	70	0.1
Standby Power Loss: 5 Watts					

5. Electrical Power Wiring and Installation

5.1. Power Connection Diagram

Diagram	Information	Section
	Incoming AC Supply For Single Phase Supply Drives: Connect L to L1, N to L2 terminals. For Three Phase Supply Drives: Connect L1, L2 and L3. Phase sequence is not important. External Mains Disconnect External Fusing / Protection Optional External AC Line Choke Optional External EMC filter Compact 2 Drive Unit Ground and PE connection Motor Cable Motor	5.3 5.3.3 5.3.4 5.6 5.3.2

5.2. Protective Earth (PE) Connection

Grounding Guidelines

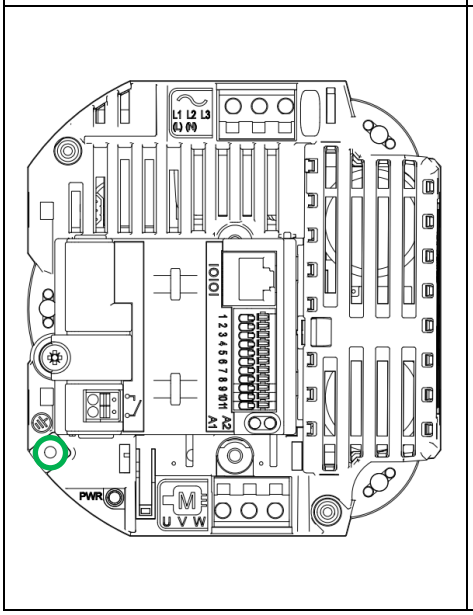
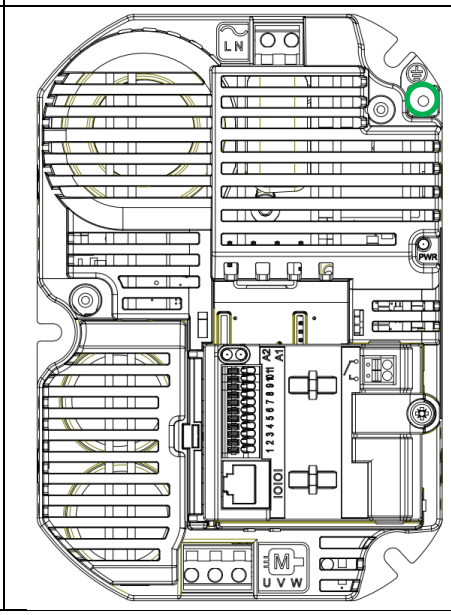
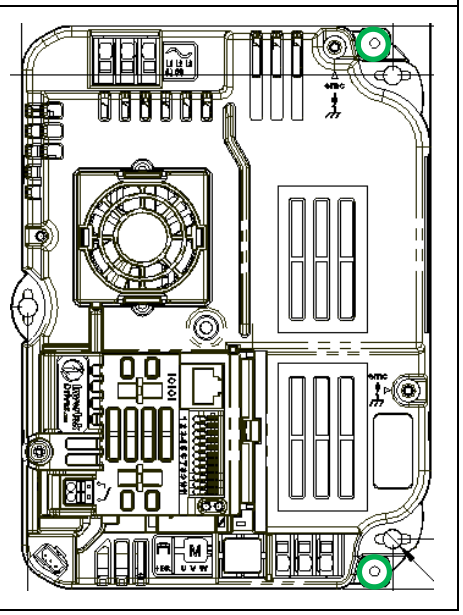
- The ground terminal of each Optidrive should be individually connected DIRECTLY to the site ground bus bar (through the filter if installed). Optidrive ground connections should not loop from one drive to another, or to, or from any other equipment.
- Ground loop impedance must confirm to local industrial safety regulations.
- To meet UL regulations, UL approved ring crimp terminals should be used for all ground wiring connections.
- The drive Safety Ground must be connected to system ground.
- Ground impedance must conform to the requirements of national and local industrial safety regulations and/or electrical codes.
- The integrity of all ground connections should be checked periodically.

Protective Earth Conductor

- The cross-sectional area of the PE Conductor must be at least equal to that of the incoming supply conductor.

PE Connection

The PE connection must be directly connected to ground. PE connection locations for each model are highlighted below.

Frame Size 1A and 1B	Frame Size 1C	Frame Size 2
		

Safety Ground

This is the safety ground for the drive that is required by code. One of these points must be connected to adjacent building steel (girder, joist), a floor ground rod, or bus bar. Grounding points must comply with national and local industrial safety regulations and/or electrical codes.

Motor Ground

The motor ground must be connected to one of the ground terminals on the drive.

Ground Fault Monitoring

As with all inverters, a leakage current to earth can exist. The Optidrive is designed to produce the minimum possible leakage current whilst complying with worldwide standards. The level of current is affected by motor cable length and type, the effective switching frequency, the earth connections used and the type of RFI filter installed. If an ELCB (Earth Leakage Circuit Breaker) is to be used, the following conditions apply: -

- A Type B Device must be used
- The device must be suitable for protecting equipment with a DC component in the leakage current
- Individual ELCBs should be used for each Optidrive

Shield Termination (Cable Screen)

The safety ground terminal provides a grounding point for the motor cable shield. The motor cable shield connected to this terminal (drive end) should also be connected to the motor frame (motor end). Use a shield terminating or EMI clamp to connect the shield to the safety ground terminal.

5.3. Incoming Power Connection

5.3.1. General

- Optidrive Compact Drive models are Over Voltage Category III according to EN60664-1:2007. Auxiliary circuits must be Over Voltage category II.
- Models intended for 200 - 240VAC supply are suitable for use on a circuit capable of delivering not more than 5kA symmetrical amperes, 230VAC maximum when protected by Class J Fuses rated according to the values shown in section 11.9 Electrical Rating Tables on page 54.
- Models intended for 380 - 480VAC supply are suitable for use on a circuit capable of delivering not more than 5kA symmetrical amperes, 480VAC maximum when protected by Class J Fuses rated according to the values shown in section 11.9 Electrical Rating Tables on page 54.
- For Canadian installations, transient surge suppression shall be installed on the line side of this equipment and shall be rated 230V (for 200 – 240VAC rated units) or 480V (for 380 – 480VAC rated units) phase to ground, 230V (for 200 – 240VAC rated units) or 480V (for 380 – 480VAC rated units) phase to phase, suitable for overvoltage category III and shall provide protection for a rated impulse withstand voltage peak of 2.5kV.

5.3.2. Cable Selection

- For 1 phase supply, the mains power cables should be connected to L1/L, L2/N.
- For 3 phase supplies, the mains power cables should be connected to L1, L2, and L3. Phase sequence is not important.
- The cables should be dimensioned according to any local codes or regulations. Maximum dimensions are given in section 11.9 Electrical Rating Tables on page 54.
- The cable must be sufficient to carry the drive load current. Refer to section 11.9 Electrical Rating Tables on page 54.
- For compliance with CE and C Tick EMC requirements, refer to section 5.6 EMC Compliant Installation on page 20.
- A fixed installation is required according to IEC61800-5-1 with a suitable disconnecting device installed between the Optidrive and the AC Power Source. The disconnecting device must conform to the local safety code / regulations (e.g. within Europe, EN60204-1, Safety of machinery).
- For UL compliant installation, cables must be rated for continuous conductor temperature of 75°C, copper only.

5.3.3. Fuse / Circuit Breaker Selection

- Suitable fuses to provide wiring protection of the input power cable should be installed in the incoming supply line, according to the data in section 11.9 Electrical Rating Tables on page 54. The fuses must comply with any local codes or regulations in place. In general, type gG (IEC 60269) or UL type J fuses are suitable; however, in some cases type aR fuses may be required. The operating time of the fuses must be below 0.5 seconds.
- Where allowed by local regulations, suitably dimensioned type B MCB circuit breakers of equivalent rating may be utilised in place of fuses, providing that the clearing capacity is sufficient for the installation.
- The maximum permissible short circuit current at the Optidrive Power terminals as defined in IEC60439-1 is 5kA.

5.3.4. Optional Input Choke

- An optional Input Choke is recommended to be installed in the supply line for drives where any of the following conditions occur: -
  - The incoming supply impedance is low, or the fault level / short circuit current is high
  - The supply is prone to dips or brown outs
  - An imbalance exists on the supply (3 phase drives)
  - The power supply to the drive is via a busbar and brush gear system (typically overhead Cranes).
- In all other installations, an input choke is recommended to ensure protection of the drive against power supply faults. Part numbers are shown in the table.

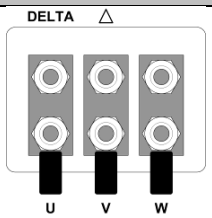
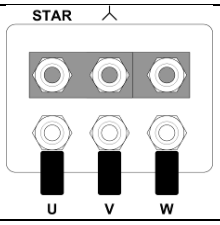
Supply	Output Current	AC Input Inductor
230 Volt, 1 Phase	Up to 7A	OPT-2-L1016-20
400 Volt, 3 Phase	Up to 5.8A	OPT-2-L3006-20
	Up to 9.5A	OPT-2-L3010-20

5.4. Motor Connection

- The drive inherently produces fast switching of the output voltage (PWM) to the motor compared to the mains supply, for motors which have been wound for operation with a variable speed drive then there is no preventative measures required, however if the quality of insulation is unknown then the motor manufacturer should be consulted and preventative measures may be required.
- The motor should be connected to the Optidrive U, V, and W terminals using a suitable 3 or 4 core cable. Where a 3-core cable is utilised, with the shield operating as an earth conductor, the shield must have a cross sectional area at least equal to the phase conductors when they are made from the same material. Where a 4-core cable is utilised, the earth conductor must be of at least equal cross-sectional area and manufactured from the same material as the phase conductors.
- The motor earth must be connected to one of the Optidrive earth terminals.

5.5. Motor Terminal Box Connections

Most general-purpose motors are wound for operation on dual voltage supplies. This is indicated on the nameplate of the motor. This operational voltage is normally selected when installing the motor by selecting either STAR or DELTA connection. STAR always gives the higher of the two voltage ratings.

Incoming Supply Voltage	Motor Nameplate Voltages	Connection	
230	230 / 400	Delta	
400	400 / 690		
400	230 / 400	Star	

5.6. EMC Compliant Installation

5.6.1. Conducted Emissions According to EN61800-3

For compliance with the following conducted emission categories defined according to EN61800-3, the steps listed below are required.

Category	Supply Cable Type	Motor Cable Type	Control Cables	Maximum Permissible Motor Cable Length
C1[6]	Unshielded[3]	Shielded[1,5]	Shielded[4]	1M / 1M[7]
C2	Unshielded[3]	Shielded[1, 5]		3M / 3M[7]
C3	Unshielded[3]	Shielded[2]		10M / 10M[7]

1/ A screened (shielded) cable suitable for fixed installation with the relevant mains voltage in use. Braided or twisted type screened cable where the screen covers at least 85% of the cable surface area, designed with low impedance to HF signals. Installation of a standard cable within a suitable steel or copper tube is also acceptable.
2/ A cable suitable for fixed installation with relevant mains voltage with a concentric protection wire. Installation of a standard cable within a suitable steel or copper tube is also acceptable.
3/ A cable suitable for fixed installation with relevant mains voltage. A shielded type cable is not necessary. The cable must be physically separate from any other cables which may carry noise.
4/ A shielded cable with low impedance shield. Twisted pair cable is recommended for analog signals.
5/ The cable screen should be terminated at the motor end using an EMC type gland allowing connection to the motor body through the largest possible surface area. Where drives are mounted in a steel control panel enclosure, the cable screen may be terminated directly to the control panel using a suitable EMC clamp or gland, as close to the drive as possible.
6/ Compliance with category C1 conducted emissions only are achieved. For compliance with category C1 radiated emissions, additional measures may be required, contact your Sales Partner for further assistance.
7/ Permissible cable length with additional external EMC filter.

5.6.2. Radiated Emissions According to EN61800-3

Compliance with EN61800-3 standard for radiated emissions and the categories defined under the standard is dependent on the nature of the installation. Compliance can only be determined by testing in an approved laboratory. It may be necessary to add additional components, such as ferrites to any cables to ensure compliance. The following list provides some outline guidance on what measures may be required.

- Mount the drive inside a grounded metallic enclosure
- Ensure any openings in the enclosure are kept as small as possible
- If necessary, add EMC gaskets to any removable cover assemblies
- Use a shielded motor cable
- Pay careful attention to cable routing within the enclosure to ensure noise is not transferred between cables. It is important to observe correct segregation between power and signal cables and also input / output cables.
- Keep all cables as short as possible
- Use shielding between cables to prevent noise transfer where required
- Ferrites may be added to any cables which must connect externally to minimise radiated noise

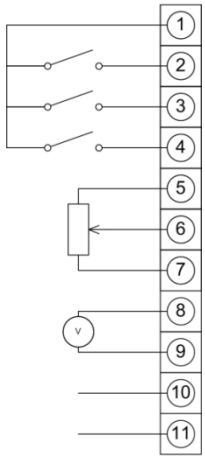
6. Control Wiring

6.1. Control Terminal Wiring

- All analog signals should be connected using suitably shielded, twisted pair cables.
- Power and Control Signal cables should be routed separately where possible and must not be routed parallel to each other.
- Signal levels of different voltages e.g. 24 Volt DC and 110 Volt AC, should not be routed in the same cable.
- Control Cable entries accept a single conductor, maximum size: 0.05 – 0.5mm^2 / 20 – 26 AWG.

6.2. Control Terminal Connections

Default Connections



Control Terminal	Signal	Description	
1	+24V User Output,	+24V, 100mA.	
2	Digital Input 1	Positive logic “Logic 1” input voltage range: 8V … 30V DC “Logic 0” input voltage range: 0V … 4V DC	
3	Digital Input 2		
4	Digital Input 3 / Analog Input 2	Digital: Logic 1 = 8 to 30V Analog: 0 to 10V, 0 to 20mA or 4 to 20mA	
5	+10V User Output	+10V, 10mA, 1kΩ minimum	
6	Analog Input 1 / Digital Input 4	Analog: 0 to 10V, 0 to 20mA or 4 to 20mA Digital: 8 to 30V	
7	0V	0 Volt Common, internally connected to terminal 9	
8	Analog Output / Digital Output	Analog: 0 to 10V, Digital: 0 to 24V	20mA maximum
9	0V	0 Volt Common, internally connected to terminal 7	
10	Modbus RTU -		
11	Modbus RTU +		
RL1-A	Relay Common	Contacts rated for 250VAC, 6A / 30VDC, 5A Intended for resistive load.	
RL1-B	Relay NO Contact		

6.3. Analog Output

The analog output function may be configured using parameter P-25, which is described in section 7.4.2 **Extended parameters**on page 25.
The output has two operating modes, dependent on the parameter selection.

- Analog Mode
  - The output is a 0 – 10 volt DC signal, 20mA max load current
- Digital Mode
  - The output is 24 volt DC, 20mA max load current

6.4. Relay Output

The relay output function may be configured using parameter P-18, which is described in section 7.4.2 **Extended parameters** on page 25.

6.5. Analog Inputs

Two analog inputs are available, which may also be used as Digital Inputs if required. The signal formats are selected by parameters as follows

- Analog Input 1 Format Selection Parameter P-16
- Analog Input 2 Format Selection Parameter P-47

These parameters are described more fully in section 7.4.2 **Extended parameters** on page 25.
The function of the analog input, e.g. for speed reference or PID feedback for example is defined by parameters P-12 and P-15. The function of these parameters and available options are described in section 8.3 Macro Function Guide on page 32.

6.6. Digital Inputs

Up to four digital inputs are available. The function of each input is defined by parameters P-12 and P-15, which are explained in section 8.3 Macro Function Guide on page 32.

6.7. Motor Thermistor Connection

Where a motor thermistor is to be used, it should be connected as follows:

Control Terminal Strip

1	2	3	4

Additional Information

- Compatible Thermistor: PTC Type
- Trip Level: >=2.5kΩ
- Reset Level: =<1.9 kΩ
- The thermistor input is monitored at all times, except during Fire Mode operation. The drive may trip even if it is disabled.
- Use suitable settings of P-12 and P-15 which have Input 3 function as External Trip, e.g. P-12 = 0, P-15 = 3. Refer to section 7 for further information.
- Set P-47 = “PtC-th". If this setting is not used, the drive will display “E-trp” only if the thermistor exceeds the threshold level during operation.

6.8. Internal Thermal Overload Protection

All models incorporate internal overload protection for the motor load that does not require the use of an external or remote overload protection device. The protection is in the form of an “I.t-trP” trip after delivering >100% of the value set in P-08 for a sustained period of time (e.g. 150% for 60 seconds). The overload level (current limit) is adjustable in parameter P-54.

7. Parameter Set Overview

7.1. About this section

This document provides a list of the available parameters, and a description of their respective functions, for the Optidrive Compact. Access to the parameters requires one of the following

- Optiport LED Remote Keypad
- Optipad TFT Remote Keypad
- Optitools Studio PC Software

7.2. Parameter Structure Overview and Access

The parameter set is arranged in Groups according to the following structure:

Parameter Group	Range	Access Level	Access Type
P00	P00-01 to P00-20	Extended	Read Only
	P00-21 to P00-50	Advanced	Read Only
Basic Parameters	P-01 to P-14	Basic	Read / Write
Extended Parameters	P-15 to P-50	Extended	Read / Write
Advanced Parameters	P-51 to P-60	Advanced	Read / Write

Access to all parameter groups is controlled by setting P-14 as follows
P-14 = P-37 (Factory setting: 101) Allows Extended Parameter Access
P-14 = P-37 + 100 (Factory Setting: 201) Allows Advanced Parameter Access

In order to prevent possible damage to the drive and connected machinery, certain parameters are locked during operation of the drive to prevent change. In the case that the drive is enabled, and the user tries to change the parameter, an “L” is shown on the left of the display.

7.3. Additional Information

7.3.1. Speed Related Parameters – Working with Hz or RPM

Optidrive Compact provides the user the option to work with all speed related parameters in Hz or RPM.

- If Parameter P-10 (Motor Rated Speed) = 0, all speed related parameters are set in Hz.
- If P-10 > 0
  - Slip Compensation is automatically enabled
  - All speed related parameters are converted to RPM values
  - Maximum speed at motor rated frequency is automatically corrected to match the synchronous operating speed of the motor
  - E.g
    - If P-01 (Maximum Output Frequency) = 50Hz
    - P-09 (Motor Rated Frequency) = 50Hz
    - The user then adjusts P-10 (Motor Rated Speed) = 1450RPM
    - The drive firmware will automatically apply slip frequency compensation, and P-01 value will automatically be adjusted to 1500RPM

The following parameters will use RPM whenever P-10 > 0.

- P-01
- P-02
- P-20
- P-21
- P-22
- P-26
- P-27
- P-29
- P-58

In addition, P-40 (Display Scaling Source) will also use RPM.

7.4. Parameter List

7.4.1. Basic Parameters

Par.	Description	Minimum	Maximum	Default	Units
P-01	**Maximum Frequency / Speed Limit**	P-02	500.0	50.0 (60.0)	Hz / RPM
	Maximum output frequency or motor speed limit set in Hz or RPM. The maximum possible value is limited by the lower of the following: - - 500.0Hz maximum limit - If P-10 >0, (500 x 120) / Motor Poles RPM - P-17 / 16 Hz **Note** When P-10>0, slip compensation is automatically enabled, and P-01 is corrected to the synchronous speed of the motor.				
P-02	**Minimum Frequency / Speed Limit**	0.0	P-01	0.0	Hz / RPM
	Minimum speed limit – Hz or RPM. If P-10 >0, the value entered / displayed is in RPM				
P-03	**Acceleration Ramp Time**	0.00	600.0	5.0	s
	Acceleration ramp time from zero Hz / RPM to base frequency (P-09) in seconds.				
P-04	**Deceleration Ramp Time**	0.00	600.0	5.0	s
	Deceleration ramp time from base frequency (P-09) to standstill in seconds. When set to 0.00, the value of P-24 is used.				
P-05	**Stopping Mode**	0	3	0	-

Setting	Description	Behaviour on Disable (Stop)	Behaviour on Mains Loss
0	Ramp to Stop with Mains Loss Ride Through.	Ramp to stop, rate controlled by P-04.	Continue running by reducing the speed of the load to recover energy.
1	Coast to Stop	Coast (freewheel) to stop	
2	Ramp to Stop	Ramp to stop, rate controlled by P-04.	Ramp to stop using the P-24 decel ramp
3	AC Flux Braking	As setting 2, but AC flux braking is also applied, increasing the level of available braking torque.	As setting 2, but AC flux braking is also applied, increasing the level of available braking torque.

P-06	**Energy Optimiser**	0	1	0	-

Setting	Function	Description
0	**Disabled**	
1	**Enabled**	When enabled, the Energy Optimiser attempts to reduce the overall energy consumed by the drive and motor by reducing the output voltage during constant speed, light load operation. The Energy Optimiser is intended for applications where the drive may operate for some periods of time with constant speed and light motor load, whether constant or variable torque.

P-07	**Motor Rated Voltage / Back EMF at rated speed (PM / BLDC)**	0	250 / 500	230 / 400	V
	For Induction Motors, this parameter should be set to the rated (nameplate) voltage of the motor (Volts). For Permanent Magnet or Brushless DC Motors, it should be set to the Back EMF at rated speed.				
P-08	**Motor Rated Current**	Drive Rating Dependent			A
	This parameter should be set to the rated (nameplate) current of the motor. This parameter cannot be adjusted greater than the continuous current rating of the drive. When the motor nameplate value is entered, thermal overload protection is enabled, as described in section 3.6.3				
P-09	**Motor Rated Frequency**	25	500	50 (60)	Hz
	This parameter should be set to the rated (nameplate) frequency of the motor				
P-10	**Motor Rated Speed**	0	30000	0	RPM
	This parameter can optionally be set to the rated (nameplate) RPM of the motor. When set to the default value of zero, all speed related parameters are displayed in Hz, and the slip compensation for the motor is disabled. Entering the value from the motor nameplate enables the slip compensation function, and the Optidrive display will now show motor speed in estimated RPM. All speed related parameters, such as Minimum and Maximum Speed, Preset Speeds etc. will also be displayed in RPM. **Note** If P-09 value is changed, P-10 value is reset to 0.				
P-11	**Low Frequency Torque Boost Current**	0.0	Drive Dependent	3.0	%
	Low Frequency Torque Boost is used to increase the applied motor voltage and hence current at low output frequencies. This can improve low speed and starting torque. Increasing the boost level will increase motor current at low speed, which may result in the motor temperature rising - force ventilation of the motor may then be required. In general, the lower the motor power, the higher the boost setting that may be safely used. For IM motors, when P-51 = 0 1 or 1, a suitable setting can usually be found by operating the motor under very low or no load conditions at approximately 5Hz, and adjusting P-11 until the motor current is approximately the magnetising current (if known) or in the range shown below. Frame Size 1: 60 – 80% of motor rated current Frame Size 2: 50 – 60% of motor rated current Frame Size 3: 40 – 50% of motor rated current Frame Size 4: 35 – 45% of motor rated current This parameter is also effective when using alternative motor types, P-51 = 2, 3 or 4. In this case, the boost current level is defined as 4*P-11*P-08				

Par.	Description			Minimum	Maximum	Default	Units
P-12	**Primary Command Source**			0	6	0	-
	Setting	**Function**	**Description**				
	0	**Terminal Control**	The drive responds directly to signals applied to the control terminals.				
	1	**Uni-directional Keypad Control**	The drive can be controlled in the forward direction only using an external or remote Keypad				
	2	**Bi-directional Keypad Control**	The drive can be controlled in the forward and reverse directions using an external or remote Keypad. Pressing the keypad START button toggles between forward and reverse.				
	3	**Modbus Network Control**	Control via Modbus RTU (RS485) using the internal Accel / Decel ramps				
	4	**Modbus Network Control**	Control via Modbus RTU (RS485) interface with Accel / Decel ramps updated via Modbus				
	5	**PI Control**	User PI control with external feedback signal				
	6	**PI Analog Summation Control**	PI control with external feedback signal and summation with analog input 1				
	7	**CAN open Control**	Control via CAN (RS485) using the internal Accel / Decel ramps				
	8	**CAN open Control**	Control via CAN (RS485) interface with Accel / Decel ramps updated via CAN				
	9	**Slave Mode**	Control via a connected Invertek drive in Master Mode. Slave drive address must be > 1.				
	NOTE When P-12 = 1, 2, 3, 4, 7, 8 or 9, an enable signal must still be provided at the control terminals, digital input 1						
P-13	**Operating Mode Select**			0	2	0	-
	Setting	**Function**	**Description**				
	0	**General Purpose**	Intended for most standard applications, parameters are configured for constant torque operation with 150% overload allowed for 60 seconds, spin start is disabled.				
	1	**Pump Mode**	Intended for pump applications, parameters are configured for variable torque operation with 110% overload allowed for 60 seconds, spin start is disabled.				
	2	**Fan Mode**	Intended for Fan applications, parameters are configured for variable torque operation with 110% overload allowed for 60 seconds, spin start is enabled.				
P-14	**Extended Menu Access code**			0	65535	0	-
	Enables access to Extended and Advanced Parameter Groups. This parameter must be set to the value programmed in P-37 (default: 101) to view and adjust Extended Parameters and value of P-37 + 100 to view and adjust Advanced Parameters. The code may be changed by the user in P-37 if desired.						

7.4.2. Extended parameters

Par.	Description	Minimum	Maximum	Default	Units
P-15	**Digital Input Function Select**	0	15	0	-
	Defines the function of the digital inputs depending on the control mode setting in P-12. See section 8 Control Terminal Connections for more information.				
P-16	**Analog Input 1 Signal Format**	See Below		U0-10	-

Setting	Function	Description
U 0- 10	0 to 10V Uni-direction	The drive will remain at P-01 if the analog reference after scaling and offset are applied is =<0.0%
b 0- 10	0 to 10V bi-directional	The drive will operate the motor in the reverse direction of rotation if the analog reference after scaling and offset are applied is <0.0%
A 0-20	0 to 20mA	
t 4-20	4 to 20mA	The drive will trip and show the fault code 4-20F if the signal level falls below 3mA
r 4-20	4 to 20mA	The drive will run at Preset Speed 1 (P-20) if the signal level falls below 3mA
t 20-4	20 to 4mA	The drive will trip and show the fault code 4-20F if the signal level falls below 3mA
r 20-4	20 to 4mA	The drive will run at Preset Speed 1 (P-20) if the signal level falls below 3mA
U 10-0	10 to 0V	The drive will operate at Maximum Frequency / Speed if the analog reference after scaling and offset are applied is =<0.0%

P-17	**Maximum Effective Switching Frequency**	4	32	8	kHz
	Sets maximum effective switching frequency of the drive. If "rEd" is displayed, the switching frequency has been reduced to the level in P00-32 due to excessive drive heatsink temperature.				
P-18	**Output Relay Function Select**	0	9	1	-
	Selects the function assigned to the relay output. The relay has two output terminals, Logic 1 indicates the relay is active, and therefore terminals 10 and 11 will be connected.				

Setting	Function	Logic 1 when
0	**Drive Enabled (Running)**	The motor is enabled
1	**Drive Healthy**	Power is applied to the drive and no fault exists
2	**At Target Frequency (Speed)**	The output frequency matches the setpoint frequency
3	**Drive Tripped**	The drive is in a fault condition
4	**Output Frequency >= Limit**	The output frequency exceeds the adjustable limit set in P-19
5	**Output Current >= Limit**	The motor current exceeds the adjustable limit set in P-19
6	**Output Frequency < Limit**	The output frequency is below the adjustable limit set in P-19
7	**Output Current < Limit**	The motor current is below the adjustable limit set in P-19
8	**Analog Input 2 > Limit**	The signal applied to analog input 2 exceeds the adjustable limit set in P-19
9	**Drive Ready to Run**	The drive is ready to run, no trip present.

P-19	**Relay Threshold Level**	0.0	200.0	100.0	%
	Adjustable threshold level used in conjunction with settings 4 to 7 of P-18				
P-20	**Preset Frequency / Speed 1**	P-02	P-01	5.0	Hz / RPM
P-21	**Preset Frequency / Speed 2**	P-02	P-01	25.0	Hz / RPM
P-22	**Preset Frequency / Speed 3**	P-02	P-01	40.0	Hz / RPM
P-23	**Preset Frequency / Speed 4**	P-02	P-01	P-09	Hz / RPM
	Preset Speeds / Frequencies selected by digital inputs depending on the setting of P-15 If P-10 = 0, the values are entered as Hz. If P-10 > 0, the values are entered as RPM. **Note** Changing the value of P-09 will reset all values to factory default settings				
P-24	**2nd Deceleration Ramp Time (Fast Stop)**	0.00	600.0	0.00	s
	This parameter allows an alternative deceleration ramp down time to be programmed into the Optidrive, which can be selected by digital inputs (dependent on the setting of P-15) or selected automatically in the case of a mains power loss if P-05 = 2 or 3. When set to 0.00, the drive will coast to stop.				
P-25	**Analog Output Function Select**	0	11	8	-

Digital Output Mode. Logic 1 = +24V DC

Setting	Function	Logic 1 when…
0	**Drive Enabled (Running)**	The Optidrive is enabled (Running)
1	**Drive Healthy**	No Fault condition exists on the drive
2	**At Target Frequency (Speed)**	The drive is in a fault condition
3	**Drive Tripped**	
4	**Output Frequency >= Limit**	The output frequency exceeds the adjustable limit set in P-19
5	**Output Current >= Limit**	The motor current exceeds the adjustable limit set in P-19
6	**Output Frequency < Limit**	The output frequency is below the adjustable limit set in P-19
7	**Output Current < Limit**	The motor current is below the adjustable limit set in P-19

Analog Output Mode

Setting	Description	Range
8	**Output Frequency (Motor Speed)**	0 to P-01, resolution 0.1Hz
9	**Output (Motor) Current**	0 to 200.0% of P-08, updated every 256ms
10	**Output Power**	0 – 200.0% of drive rated power
11	**Load Current (Torque)**	0 – 200.0% of P-08, updated every 64ms

Par.	Description	Minimum	Maximum	Default	Units
P-26	**Skip frequency hysteresis band**	0.0	P-01	0.0	Hz / RPM
P-27	**Skip Frequency Centre Point**	0.0	P-01	0.0	Hz / RPM
	The Skip Frequency function is used to avoid the Optidrive operating at a certain output frequency, for example at a frequency which causes mechanical resonance in a particular machine. Parameter P-27 defines the centre point of the skip frequency band and is used in conjunction with P-26. The Optidrive output frequency will ramp through the defined band at the rates set in P-03 and P-04 respectively and will not hold any output frequency within the defined band. If the frequency reference applied to the drive is within the band, the Optidrive output frequency will remain at the upper or lower limit of the band.				
P-28	**V/F Characteristic Adjustment Voltage**	0	250 / 500	0	V
P-29	**V/F Characteristic Adjustment Frequency**	0.0	P-09	0.0	Hz
	This parameter in conjunction with P-28 sets a frequency point at which the voltage set in P-29 is applied to the motor. Care must be taken to avoid overheating and damaging the motor when using this feature.				
P-30	**Start Mode, Automatic Restart, Fire Mode Configuration**				
	Index 1: Start Mode & Automatic Restart				
	Selects whether the drive should start automatically if the enable input is present and latched during power on. Also configures the Automatic Restart function.				

Setting	Start Function	Auto Restarts	Description
EdGE-r	Edge Run	0	Following Power on or reset, the drive will not start if Digital Input 1 remains closed. The Input must be closed after a power on or reset to start the drive.
AUto-0	Auto	0	Following a Power On or Reset, the drive will automatically start if Digital Input 1 is closed.
AUto-1	Auto	1	As AUto-0. In addition, following a trip, the drive will make up to 5 attempts to restart at 20 second intervals. The numbers of restart attempts are counted, and if the drive fails to start on the final attempt, the drive will trip with a fault, and will require the user to manually reset the fault. The drive must be powered down to reset the counter.
AUto-2	Auto	2	
AUto-3	Auto	3	
AUto-4	Auto	4	
AUto-5	Auto	5	

	Index 2: Fire Mode Input Logic	0	1	0	-
	Defines the operating logic when a setting of P-15 is used which includes Fire Mode, e.g. settings 15, 16 & 17.				

Setting	Input Type	Fire Mode Active When
0	**Normally Closed (NC)**	Input is open
1	**Normally Open (NO)**	Input is closed

	Index 3: Fire Mode Input Type	0	1	0	-
	Defines the input type when a setting of P-15 is used which includes Fire Mode, e.g. settings 15, 16 & 17.				

Setting	Input Type	Description
0	**Maintained Input**	The drive will remain in Fire Mode, only as long the fire mode input signal remains (Normally Open or Normally Closed operation is supported depending on Index 2 setting).
1	**Momentary Input**	Fire Mode is activated by a momentary signal on the input. Normally Open or Normally Closed operation is supported depending on Index 2 setting. The drive will remain in Fire Mode until disabled or powered off.

P-31	**Keypad Start Mode Select**	0	3	1	-
	This parameter is active only when operating in Keypad Control Mode (P-12 = 1 or 2) or Modbus Mode (P-12 = 3 or 4). When settings 0 or 1 are used, the Keypad Start and Stop keys are active, and control terminals 1 and 2 must be linked together. Settings 2 and 3 allow the drive to be started from the control terminals directly, and the keypad Start and Stop keys are ignored.				

Setting	Start At	Enable From
0	Minimum Speed	Keypad
1	Previous Speed	Keypad
2	Minimum Speed	Terminal
3	Previous Speed	Terminal
4	Present Speed	Keypad
5	Preset Speed 4 (P-23)	Keypad
6	Present Speed	Terminal
7	Preset Speed 4 (P-23)	Terminal

P-32	**Index 1: Duration**	0.0	25.0	0.0	s
	Index 2: DC Injection Mode	0	2	0	-
	Index 1: Defines the time for which a DC current is injected into the motor. DC Injection current level may be adjusted in P-59.				
	Index 2: Configures the DC Injection Function as follows: -				

Setting	Function	Description
0	**DC Injection on Stop**	DC is injected into the motor at the current level set in P-59 following a stop command, after the output frequency has reached 0.0Hz for the time set in Index 1. This can be useful to ensure the motor has reached a complete stop before the drive disables.
1	**DC Injection on Start**	DC is injected into the motor at the current level set in P-59 for the time set in Index 1 immediately after the drive is enabled, prior to the output frequency ramping up. The output stage remains active during this phase. This can be used to ensure the motor is at standstill prior to starting.
2	**DC Injection on Start & Stop**	DC injection applied as both settings 0 and 1 above.

Par.	Description	Minimum	Maximum	Default	Units
P-33	**Spin Start (S2 & S3 Only) / DC Injection Time on Start (S1 Only)**	0	2	0	-

Setting	Function	Description
0	**Disabled**	
1	**Enabled**	When enabled, on start up the drive will attempt to determine if the motor is already rotating and will begin to control the motor from its current speed. A short delay may be observed when starting motors which are not turning.
2	**Enabled on Trip, Brown Out or Coast Stop**	Spin start is only activated following the events listed, otherwise it is disabled.

Par.	Description	Minimum	Maximum	Default	Units
P-34	**Brake Chopper Enable (Not Size 1)**	0	2	0	-

Setting	Function	Description
0	**Disabled**	
1	**Enabled with Software Protection**	Enables the internal brake chopper with software protection for a 200W continuous rated resistor
2	**Enabled Without Software Protection**	Enables the internal brake chopper without software protection. An external thermal protection device should be fitted
3	**Enabled with Software Protection**	As setting 1, however the Brake Chopper is only enabled during a change of the frequency setpoint, and is disabled during constant speed operation
4	**Enabled Without Software Protection**	As setting 2, however the Brake Chopper is only enabled during a change of the frequency setpoint and is disabled during constant speed operation.

Par.					
P-35	**Analog Input 1 Scaling / Slave Speed Scaling**	0.0	2000.0	100.0	%
	Analog Input 1 Scaling. The analog input signal level is multiplied by this factor, e.g. if P-16 is set for a 0 – 10V signal , and the scaling factor is set to 200.0%, a 5 volt input will result in the drive running at maximum frequency / speed (P-01) **Slave Speed Scaling**. When operating in Slave Mode (P-12 = 9), the operating speed of the drive will be the Master speed multiplied by this factor, limited by the minimum and maximum speeds.				
P-36	**Serial Communications Configuration**	See Below			
	Index 1: Address	0	63	1	-
	Index 2: Baud Rate	9.6	1000	115.2	kbps
	Index 3: Communication loss protection	0	3000	300	ms
	This parameter has three sub settings used to configure the Modbus RTU Serial Communications. The Sub Parameters are				
	Index 1: Drive Address: Range: 0 – 63, default: 1				
	Index 2: Baud Rate & Network type: Selects the baud rate and network type for the internal RS485 communication port. For Modbus RTU: Baud rates 9.6, 19.2, 38.4, 57.6, 115.2 kbps are available. For CAN Open: Baud rates 125, 250, 500 & 1000 kbps are available.				
	Index 3: Watchdog Timeout: Defines the time for which the drive will operate without receiving a valid command telegram to Register 1 (Drive Control Word) after the drive has been enabled. Setting 0 disables the Watchdog timer. Setting a value of 30, 100, 1000, or 3000 defines the time limit in milliseconds for operation. A '?' suffix selects trip on loss of communication. An '?' suffix means that the drive will coast stop (output immediately disabled) but will not trip.				
P-37	**Access Code Definition**	0	9999	101	-
	Defines the access code which must be entered in P-14 to access parameters above P-14				
P-38	**Parameter Access Lock**	0	1	0	-

Setting	Function	Description
0	**Unlocked**	All parameters can be accessed and changed
1	**Locked**	Parameter values can be displayed but cannot be changed except P-38.

Par.					
P-39	**Analog Input 1 Offset**	-500.0	500.0	0.0	%
	Sets an offset, as a percentage of the full-scale range of the input, which is applied to the analog input signal. This parameter operates in conjunction with P-35, and the resultant value can be displayed in P00-01. The resultant value is defined as a percentage, according to the following: - P00-01 = (Applied Signal Level (%) - P-39) x P-35)				
P-40	**Index 1: Display Scaling Factor**	0	3	0	-
	Index 2: Display Scaling Source	0.000	16.000	0.000	-
	Allows the user to program the Optidrive to display an alternative output unit scaled from either output frequency (Hz), Motor Speed (RPM) or the signal level of PI feedback when operating in PI Mode.				
	Index 1: Used to set the scaling multiplier. The chosen source value is multiplied by this factor.				
	Index 2: Defines the scaling source as follows: -				

Setting	Function	Description
0	**Motor Speed**	Scaling is applied to the output frequency if P-10 = 0, or motor RPM if P-10 > 0.
1	**Motor Current**	Scaling is applied to the motor current value (Amps)
2	**Analog Input 2 Signal Level**	Scaling is applied to analog input 2 signal level, internally represented as 0 – 100.0%
3	**PI Feedback**	Scaling is applied to the PI feedback selected by P-46, internally represented as 0 – 100.0%

Par.					
P-41	**PI Controller Proportional Gain**	0.0	30.0	1.0	-
	PI Controller Proportional Gain. Higher values provide a greater change in the drive output frequency in response to small changes in the feedback signal. Too high a value can cause instability				
P-42	**PI Controller Integral Time**	0.0	30.0	1.0	s
	PI Controller Integral Time. Larger values provide a more damped response for systems where the overall process responds slowly.				

Par.	Description	Minimum	Maximum	Default	Units
P-43	**PI Controller Operating Mode**	0	1	0	-

Setting	Function	Description
0	**Direct Operation**	Use this mode if when the feedback signal drops, the motor speed should increase. When the drive restarts following standby, the PID controller will restart from zero.
1	**Inverse Operation**	Use this mode if when the feedback signal drops, the motor speed should decrease. When the drive restarts following standby, the PID controller will restart from zero.
2	**Direct Operation**	Use this mode if when the feedback signal drops, the motor speed should increase. When the drive restarts following standby, the PID controller will restart from maximum.
3	**Inverse Operation**	Use this mode if when the feedback signal drops, the motor speed should decrease. When the drive restarts following standby, the PID controller will restart from maximum.

Par.	Description	Minimum	Maximum	Default	Units
P-44	**PI Reference (Setpoint) Source Select**	0	1	0	-

Selects the source for the PID Reference / Setpoint

Setting	Function	Description
0	**Digital Preset Setpoint**	P-45 is used
1	**Analog Input 1 Setpoint**	Analog input 1 signal level, readable in P00-01 is used for the setpoint.

Par.	Description	Minimum	Maximum	Default	Units
P-45	**PI Digital Setpoint**	0.0	100.0	0.0	%

When P-44 = 0, this parameter sets the preset digital reference (setpoint) used for the PI Controller as a % of the feedback signal range.

Par.	Description	Minimum	Maximum	Default	Units
P-46	**PI Feedback Source Select**	0	5	0	-

Selects the source of the feedback signal to be used by the PI controller.

Setting	Function	Description
0	**Analog Input 2**	(Terminal 4) Signal level readable in P00-02.
1	**Analog Input 1**	(Terminal 6) Signal level readable in P00-01
2	**Motor Current**	Scaled as % of P-08
3	**DC Bus Voltage**	Scaled 0 – 1000 Volts = 0 – 100%
4	**Analog 1 – Analog 2**	The value of Analog Input 2 is subtracted from Analog 1 to give a differential signal. The value is limited to 0.
5	**Largest (Analog 1, Analog 2)**	The larger of the two analog input values is always used for PI feedback.

Par.	Description	Minimum	Maximum	Default	Units
P-47	**Analog Input 2 Signal Format**	-	-	-	U0-10

Setting	Signal Type	Additional Information
U 0-10	0 to 10	
A 0-20	0 to 20mA	
t 4-20	4 to 20mA	The drive will trip and show the fault code 4-20F if the signal level falls below 3mA
r 4-20	4 to 20mA	The drive will ramp to stop if the signal level falls below 3mA
t 20-4	20 to 4mA	The drive will trip and show the fault code 4-20F if the signal level falls below 3mA
r 20-4	20 to 4mA	The drive will ramp to stop if the signal level falls below 3mA
Ptc-th	Motor PTC (Thermistor)	Valid with any setting of P-15 that has Input 3 as E-Trip.

Par.	Description	Minimum	Maximum	Default	Units
P-48	**Standby Mode Timer**	0.0	25.0	0.0	s

When standby mode is enabled by setting P-48 > 0.0, the drive will enter standby following a period of operating at minimum speed (P-02) for the time set in P-48. When in Standby Mode, the drive display shows StndbY, and the output to the motor is disabled.

Par.	Description	Minimum	Maximum	Default	Units
P-49	**PI Control Wake Up Error Level**	0.0	100.0	0.0	%

When the drive is operating in PI Control Mode (P-12 = 5 or 6), and Standby Mode is enabled (P-48 > 0.0), P-49 can be used to define the PI Error Level (E.g. difference between the setpoint and feedback) required before the drive restarts after entering Standby Mode. This allows the drive to ignore small feedback errors and remain in Standby mode until the feedback drops sufficiently.

Par.	Description	Minimum	Maximum	Default	Units
P-50	**User Output Relay Hysteresis**	0.0	10.0	5.0	%

Sets the hysteresis level for P-19 to prevent the output relay chattering when close to the threshold.

7.4.3. Advanced Parameters

Par.	Description			Minimum	Maximum	Default	Units
P-51	**Motor Control Mode**			0	5	0	-
	Setting	**Control Method**					
	0	**Vector speed control mode for Induction Motors**					
	1	**V/f mode for Induction Motors**					
	2	**PM vector speed control for Permanent Magnet Motors**					
	3	**BLDC vector speed control for Brushless DC Motors**					
	4	**SR vector speed control for Synchronous Reluctance Motors**					
	5	**LSPM vector speed control for Line Start Permanent Magnet Motors**					
P-52	**Motor Parameter Autotune**			0	1	0	-
	This parameter can be used to optimise the performance when P-51 = 0. Autotune is not required if P-51 = 1. For settings 2 – 5 of P-51, autotune MUST be carried out AFTER all other required motor settings are entered.						
	Setting	**Function**	**Description**				
	0	**Disabled**					
	1	**Enabled**	When enabled, the drive immediately measures required data from the motor for optimal operation. Ensure all motor related parameters are correctly set first before enabling this parameter.				
P-53	**Vector Mode Gain**			0.1	200.0	50.0	%
	Single Parameter for Vector speed loop tuning. Affects P & I terms simultaneously. Not active when P-51 = 1.						
P-54	**Maximum Current Limit**			0.1	175.0	150.0	%
	Defines the max current limit in vector control modes						
P-55	**Motor Stator Resistance**			0.0	655.35	-	Ω
	Motor stator resistance in Ohms. Determined by Autotune, adjustment is not normally required.						
P-56	**Motor Stator d-axis Inductance (Lsd)**			0	6553.5	-	mH
	Determined by Autotune, adjustment is not normally required.						
P-57	**Motor Stator q-axis Inductance (Lsq)**			0	6553.5	-	mH
	Determined by Autotune, adjustment is not normally required.						
P-58	**DC Injection Speed**			0.0	P-01	0.0	Hz / RPM
	Sets the speed at which DC injection current is applied during braking to Stop, allowing DC to be injected before the drive reaches zero speed if desired.						
P-59	**DC Injection Current**			0.0	100.0	20.0	%
	Sets the level of DC injection braking current applied according to the conditions set in P-32 and P-58.						
P-60	**Thermal Overload Retention**			0	1	0	-
	Setting	**Function**	**Description**				
	0	**Disabled**					
	1	**Enabled**	When enabled, the drive calculated motor overload protection information is retained after the mains power is removed from the drive.				

7.5. Parameter Group 0 – Monitoring Parameters (Read Only)

Par.	Description	Explanation
P00-01	1st Analog input value (%)	100% = max input voltage
P00-02	2nd Analog input value (%)	100% = max input voltage
P00-03	Speed reference input (Hz / RPM)	Displayed in Hz if P-10 = 0, otherwise RPM
P00-04	Digital input status	Drive digital input status
P00-05	User PI output (%)	Displays value of the User PI output
P00-06	DC bus ripple (V)	Measured DC bus ripple
P00-07	Applied motor voltage (V)	Value of RMS voltage applied to motor
P00-08	DC bus voltage (V)	Internal DC bus voltage
P00-09	Heatsink temperature (°C)	Temperature of heatsink in °C
P00-10	Run time since date of manuf. (Hours)	Not affected by resetting factory default parameters
P00-11	Run time since last trip (1) (Hours)	Run-time clock stopped by drive disable (or trip), reset on next enable only if a trip occurred. Reset also on next enable after a drive power down.
P00-12	Run time since last trip (2) (Hours)	Run-time clock stopped by drive disable (or trip), reset on next enable only if a trip occurred (under-volts not considered a trip) – not reset by power down / power up cycling unless a trip occurred prior to power down
P00-13	Trip Log	Displays most recent 4 trips with time stamp
P00-14	Run time since last disable (Hours)	Run-time clock stopped on drive disable, value reset on next enable
P00-15	DC bus voltage log (V)	8 most recent values prior to trip, 256ms sample time
P00-16	Heatsink temperature log (V)	8 most recent values prior to trip, 30s sample time
P00-17	Motor current log (A)	8 most recent values prior to trip, 256ms sample time
P00-18	DC bus ripple log (V)	8 most recent values prior to trip, 22ms sample time
P00-19	Internal drive temperature log (°C)	8 most recent values prior to trip, 30 s sample time
P00-20	Internal drive temperature (°C)	Actual internal ambient temperature in °C
P00-21	CAN process data input	Incoming process data (RX PDO1) for CAN: PI1, PI2, PI3, PI4
P00-22	CAN process data output	outgoing process data (TX PDO1) for CAN: PO1, PO2, PO3, PO4
P00-23	Accumulated time with heatsink > 85°C (Hours)	Total accumulated hours and minutes of operation above heatsink temp of 85°C
P00-24	Accumulated time with drive internal temp > 80°C (Hours)	Total accumulated hours and minutes of operation with drive internal ambient above 80C
P00-25	Estimated rotor speed (Hz)	In vector control modes, estimated rotor speed in Hz
P00-26	kWh meter / MWh meter	Total number of kWh / MWh consumed by the drive.
P00-27	Total run time of drive fans (Hours)	Time displayed in hh:mm:ss. First value displays time in hrs, press up to display mm:ss.
P00-28	Software version and checksum	Version number and checksum. "1" on LH side indicates I/O processor, "2" indicates power stage
P00-29	Drive type identifier	Drive rating, drive type and software version codes
P00-30	Drive serial number	Unique drive serial number
P00-31	Motor current Id / Iq	Displays the magnetising current (Id) and torque current (Iq). Press UP to show Iq
P00-32	Actual PWM switching frequency (kHz)	Actual switching frequency used by drive
P00-33	Critical fault counter – O-I	These parameters log the number of times specific faults or errors occur and are useful for diagnostic purposes.
P00-34	Critical fault counter – O-Volts	
P00-35	Critical fault counter – U-Volts	
P00-36	Critical fault counter – O-temp (h/sink)	
P00-37	Critical fault counter – b O-I (chopper)	
P00-38	Critical fault counter – O-hEAt (control)	
P00-39	Modbus comms error counter	
P00-40	CANbus comms error counter	
P00-41	I/O processor comms errors	
P00-42	Power stage uC comms errors	
P00-43	Drive power up time (life time) (Hours)	Total lifetime of drive with power applied
P00-44	Phase U current offset & ref	Internal value
P00-45	Phase V current offset & ref	Internal value
P00-46	Phase W current offset & ref	Internal value
P00-47	Index 1: Fire mode total active time Index 2: Fire Mode Activation Count	Total activation time of Fire Mode Displays the number of times Fire Mode has been activated
P00-48	Scope channel 1 & 2	Displays signals for first scope channels 1 & 2
P00-49	Scope channel 3 & 4	Displays signals for first scope channels 3 & 4
P00-50	Bootloader and motor control	Internal value

8. Control Terminal Connections

For standard applications and operation, the basic control of the drive and functions of all drive input terminals can be configured using just two parameters, P-12 and P-15. P-12 is used to define the source of all control commands and the primary speed reference source. P-15 then allows fast selection of Analog and Digital Input functions based on a selection table.

8.1. P-12 Function

P-12 is used to select the main control source of the drive and the main speed reference according to the following table

P-12	Function	Control Source	Main Speed Reference	Notes
0	Terminal Control	Terminals	Analog Input 1	All control signals are applied to the control terminals. Functions are determined by P-15 Macro setting.
1	Keypad Control	Keypad / Terminals	Motorised Pot / Keypad	When keypad mode is selected, the default operation of the drive requires the keypad Start & Stop buttons are used to control the drive. This can be changed using P-31 to allow the drive to be started from Digital Input 1 directly.
2	Keypad Control	Keypad / Terminals	Motorised Pot / Keypad	
3	Modbus RTU	Modbus RTU	Modbus RTU	Control of the drive operation is through the Modbus RTU Interface. Acceleration and Deceleration Rates are controlled by P-03 and P-04 respectively. Digital Input 1 must be closed to allow operation.
4	Modbus RTU	Modbus RTU	Modbus RTU	Control of the drive operation is through the Modbus RTU Interface. Acceleration and Deceleration Rates are also controlled by Modbus, P-03 and P-04 are disabled. Digital Input 1 must be closed to allow operation.
5	PI Control	Terminals	PI Output	Enable / Disable control of the drive is through the drive control terminal strip. Output frequency is set by the output of the PI Controller
6	PI Control with Analog Summation	Terminals	PI Output Added to AI1	Enable / Disable control of the drive is through the drive control terminal strip. Output frequency is set by the output of the PI Controller, added to the value of analog input 1.
7	CAN	CAN	CAN	Control of the drive operation is through the CAN Interface. Acceleration and Deceleration Rates are controlled by P-03 and P-04 respectively. Digital Input 1 must be closed to allow operation.
8	CAN	CAN	CAN	Control of the drive operation is through the CAN Interface. Acceleration and Deceleration Rates are also controlled by Modbus, P-03 and P-04 are disabled. Digital Input 1 must be closed to allow operation.
9	Slave Mode	Master Drive	From Master	

8.2. Overview

Optidrive Compact 2 uses a Macro approach to simplify the configuration of the Analog and Digital Inputs. There are two key parameters which determine the input functions and drive behaviour: -

- **P-12** – Selects the main drive control source and determines how the output frequency of the drive is primarily controlled.
- **P-15** – Assigns the Macro function to the analog and digital inputs.

Additional parameters can then be used to further adapt the settings, e.g.

- **P-16** – Used to select the format of the analog signal to be connected to analog input 1, e.g. 0 – 10 Volt, 4 – 20mA
- **P-30** – Determines whether the drive should automatically start following a power on if the Enable Input is present
- **P-31** – When Keypad Mode is selected, determines at what output frequency / speed the drive should start following the enable command, and also whether the keypad start key must be pressed or if the Enable input alone should start the drive.
- **P-47** – Used to select the format of the analog signal to be connected to analog input 2, e.g. 0 – 10 Volt, 4 – 20mA

The diagrams below provide an overview of the functions of each terminal macro function, and a simplified connection diagram for each.

8.3. Macro Function Guide

Function	Explanation
STOP	Latched Input, Open the contact to STOP the drive
RUN	Latched input, Close the contact to Start, the drive will operate as long as the input is maintained
FWD↻	Latched Input, selects the direction of motor rotation FORWARD
REV↺	Latched Input, selects the direction of motor rotation REVERSE
RUN FWD↻	Latched Input, Close to Run in the FORWARD direction, Open to STOP
RUN REV↺	Latched Input, Close to Run in the REVERSE direction, Open to STOP
ENABLE	Hardware Enable Input. In Keypad Mode, P-31 determines whether the drive immediately starts, or the keypad start key must be pressed. In other modes, this input must be present before the start command is applied via the fieldbus interface.
START↥	Normally Open, Rising Edge, Close momentarily to START the drive (NC STOP Input must be maintained)
^- START -^	Simultaneously applying both inputs momentarily will START the drive (NC STOP Input must be maintained)
STOP ↧	Normally Closed, Falling Edge, Open momentarily to STOP the drive
START↥FWD↻	Normally Open, Rising Edge, Close momentarily to START the drive in the forward direction (NC STOP Input must be maintained)
START↥REV↺	Normally Open, Rising Edge, Close momentarily to START the drive in the reverse direction (NC STOP Input must be maintained)
^-FAST STOP (P-24)-^	When both inputs are momentarily active simultaneously, the drive stops using Fast Stop Ramp Time P-24
FAST STOP↧ (P-24)	Normally Closed, Falling Edge, Open momentarily to FAST STOP the drive using Fast Stop Ramp Time P-24
E-TRIP↧	Normally Closed, External Trip input. This input may be used for: ○ External Trip function ○ Motor thermistor connection (see section 6.7 Motor Thermistor Connection) When the input opens momentarily, the drive trips showing External Fault or Thermistor Over Temperature depending on P-47 setting.
Fire Mode	Activates Fire Mode, see section 8.5.1 Fire Mode
Analog Input AI1	Analog Input 1, signal format selected using P-16
Analog Input AI2	Analog Input 2, signal format selected using P-47
AI1 REF	Analog Input 1 provides the speed reference
AI2 REF	Analog Input 2 provides the speed reference
P-xx REF	Speed reference from the selected preset speed
PR-REF	Preset speeds P-20 – P-23 are used for the speed reference, selected according to other digital input status
PI-REF	PI Control Speed Reference
PI FB	Analog Input used to provide a Feedback signal to the internal PI controller
KPD REF	Keypad Speed Reference selected
INC SPD↑	Normally Open, Close the input to Increase the motor speed
DEC SPD↓	Normally Open, Close input to Decrease motor speed
FB REF	Selected speed reference from Fieldbus (Modbus RTU / CAN / Master depending on P-12 setting)
(NO)	Input is Normally Open, Close momentarily to activate the function
(NC)	Input is Normally Closed, Open momentarily to activate the function

8.3.1. Macro Functions – Terminal Mode (P-12 = 0)

P-15	DI1		DI2		DI3 / AI2		DI4 / AI1		Diagram
	0	1	0	1	0	1	0	1	
0	STOP	RUN	FWD ↻	REV ↺	AI1 REF	P-20 REF	Analog Input AI1		1
1	STOP	RUN	AI1 REF	PR-REF	P-20	P-21	Analog Input AI1		1
2	STOP	RUN	DI2	DI3	PR		P-20 - P-23	P-01	2
			0	0	P-20				
			1	0	P-21				
			0	1	P-22				
			1	1	P-23				
3	STOP	RUN	AI1 REF	P-20 REF	E-TRIP ↴	(NC)	Analog Input AI1		3
4	STOP	RUN	AI1 REF	AI2 REF	Analog Input AI2		Analog Input AI1		4
5	STOP	RUN FWD ↻	STOP	RUN REV ↺	AI1 REF	P-20 REF	Analog Input AI1		1
		^----------FAST STOP (P-24)----------^							
6	STOP	RUN	FWD ↻	REV ↺	E-TRIP ↴	(NC)	Analog Input AI1		3
7	STOP	RUN FWD ↻	STOP	RUN REV ↺	E-TRIP ↴	(NC)	Analog Input AI1		3
		^----------FAST STOP (P-24)----------^							
8	STOP	RUN	FWD ↻	REV ↺	DI3	DI4	PR		2
					0	0	P-20		
					1	0	P-21		
					0	1	P-22		
					1	1	P-23		
9	STOP	RUN↥FWD ↻	STOP	RUN↥REV↺	DI3	DI4	PR		2
		^----------FAST STOP (P-24)----------^			0	0	P-20		
					1	0	P-21		
					0	1	P-22		
					1	1	P-23		
10	(NO)	START ↥	STOP ↴	(NC)	AI1 REF	P-20 REF	Analog Input AI1		5
11	(NO)	START↥FWD ↻	STOP ↴	(NC)	(NO)	START↥REV↺	Analog Input AI1		6
		^----------FAST STOP (P-24)----------^							
12	STOP	RUN	FAST STOP↴ (P-24)	(NC)	AI1 REF	P-20 REF	Analog Input AI1		7
13	(NO)	START↥FWD ↻	STOP ↴	(NC)	(NO)	START↥REV↺	KPD REF	P-20 REF	13
		^----------FAST STOP (P-24)----------^							
14	STOP	RUN	DI2		E-TRIP ↴	(NC)	DI2	DI4	PR
							0	0	P-20
							1	0	P-21
							0	1	P-22
							1	1	P-23
15	STOP	RUN	P-23 REF	AI1	Fire Mode		Analog Input AI1		1
16	STOP	RUN	P-23 REF	P-21 REF	Fire Mode		FWD ↻	REV ↺	2
17	STOP	RUN	DI2		Fire Mode		DI2	DI4	PR
							0	0	P-20
							1	0	P-21
							0	1	P-22
							1	1	P-23
18	STOP	RUN	FWD ↻	REV ↺	Fire Mode		Analog Input AI1		1

Note:

- For information on the External Trip (E-TRIP↴) and motor thermistor monitoring function, see section 6.7 Motor Thermistor Connection.
- Fire Mode input logic (Normally Open or Normally Closed) and latching mode are selected by P-30. When the input mode is set to latched, the enable signal must be removed to reset the latch.

8.3.2. Macro Functions - Keypad Mode (P-12 = 1 or 2)

P-15	DI1		DI2		DI3 / AI2		DI4 / AI1		Diagram
	0	1	0	1	0	1	0	1	
0	STOP	ENABLE	-	INC SPD ↑	-	DEC SPD ↓	FWD ↻	REV ↺	8
				^---------- START ----------^					
1	STOP	ENABLE	PI REF						
2	STOP	ENABLE	-	INC SPD ↑	-	DEC SPD ↓	KPD REF	P-20 REF	8
				^---------- START ----------^					
3	STOP	ENABLE	-	INC SPD ↑	E-TRIP ↴	(NC)	-	DEC SPD ↓	9
				^---------- START ----------^					
4	STOP	ENABLE	-	INC SPD ↑	KPD REF	AI1 REF	Analog Input AI1		10
5	STOP	ENABLE	FWD ↻	REV ↺	KPD REF	AI1 REF	Analog Input AI1		1
6	STOP	ENABLE	FWD ↻	REV ↺	E-TRIP ↴	(NC)	KPD REF	P-20 REF	11
7	STOP	RUN FWD ↻	STOP	RUN REV ↺	E-TRIP ↴	(NC)	KPD REF	P-20 REF	11
		^----------FAST STOP (P-24)----------^							
14	STOP	ENABLE	-	-	E-TRIP ↴	(NC)	-	-	
15	STOP	ENABLE	PR REF	KPD REF	Fire Mode		P-23	P-21	2
16	STOP	ENABLE	P-23 REF	KPD REF	Fire Mode		FWD ↻	REV ↺	2
17	STOP	ENABLE	KPD REF	P-23 REF	Fire Mode		FWD ↻	REV ↺	2
18	STOP	ENABLE	AI1 REF	KPD REF	Fire Mode		Analog Input AI1		1
8,9,10,11,12, 13 = 0									

Note:

- When operating the drive in keypad mode with Digital Pot speed reference (shown as KPD REF in the table above), the motorised pot setpoint may be adjusted by the following methods:
  - Digital inputs using external pushbuttons or other method to increase the speed (shown as INC SPD ↑ in the table above) or reduce the speed (shown as DEC SPD ↓ in the table above).
  - The UP and DOWN keys on a connected remote keypad.
- When changing from any other speed reference (e.g. preset speed or analog speed) back to keypad speed reference (digital pot value) whilst the drive is running, P-31 controls the behaviour as follows:
  - P-31 = 0 or 2: Digital pot speed value will be set to Minimum Speed (P-02).
  - P-31 = 1 or 3: Digital pot will retain the previous value from last time it was selected as the speed reference.
  - P-31 = 4 or 6: Digital pot value will be updated to be the same as current motor running speed.
  - P-31 = 5 or 7: Digital pot value will be set to Preset Speed 4 (P-23).
- When the drive is not enabled:
  - P-31 = 0, 2, 4 or 6: Digital pot speed value will be set to Minimum Speed (P-02).
  - P-31 = 1 or 3: Digital pot will retain the previous value from last time it was selected as the speed reference.
  - P-31 = 5 or 7: Digital pot value will be set Preset Speed 4 (P-23).
- When P-31 = 2, 3, 6 or7
  - Closing digital input 1 (or digital input 2 if P-15 = 7) will start the drive (Auto-run).
  - The keypad START and STOP buttons have no function in this case.
  - The keypad speed can still be adjusted using the UP and DOWN buttons.
- When P-12 = 1 motor rotation direction can be selected by the following methods:
  - Preset Speed reference selected where the preset speed has a negative value.
  - Analog Input 1 speed reference selected with Analog Input 1 programmed in bidirectional mode (P-16 = b 0-10) and a suitable reference applied.
  - Using a setting of P-15 where one digital input has Reverse or Run Reverse function and using this digital input to select rotation direction.
- When P-12 = 2, in addition to the methods described above, motor rotation direction can be changed by pressing the START button on a connected remote keypad whilst the drive is already running.
- When the remote keypad is used to adjust the speed, there is a momentary delay after the first adjustment step to allow fine setting of the speed reference. When external inputs are used, no single-step delay is present.
- For information on the External Trip (E-TRIP↴) and motor thermistor monitoring function, see section 6.7 Motor Thermistor Connection.
- Fire Mode input logic (Normally Open or Normally Closed) and latching mode are selected by P-30. When the input mode is set to latched, the enable signal must be removed to reset the latch.

8.3.3. Macro Functions - Fieldbus Control Mode (P-12 = 3, 4, 7, 8 or 9)

P-15	DI1		DI2		DI3 / AI2		DI4 / AI1		Diagram
	0	1	0	1	0	1	0	1	
0	STOP	ENABLE	FB REF (Fieldbus Speed Reference, Modbus RTU / CAN / Master-Slave defined by P-12)						14
1	STOP	ENABLE	PI REF						15
3	STOP	ENABLE	FB REF	P-20 REF	E-TRIP ↴	(NC)	Analog Input AI1		3
5	STOP	ENABLE	FB REF	PR REF	P-20	P-21	Analog Input AI1		1
		^-------START (P-12 = 3 or 4 Only)-------^							
6	STOP	ENABLE	FB REF	AI1 REF	E-TRIP ↴	(NC)	Analog Input AI1		3
		^-------START (P-12 = 3 or 4 Only)-------^							
7	STOP	ENABLE	FB REF	KPD REF	E-TRIP ↴	(NC)	Analog Input AI1		3
		^-------START (P-12 = 3 or 4 Only)-------^							
14	STOP	ENABLE	-	-	E-TRIP ↴	(NC)	Analog Input AI1		16
15	STOP	ENABLE	PR REF	FB REF	Fire Mode		P-23	P-21	2
16	STOP	ENABLE	P-23 REF	FB REF	Fire Mode		Analog Input AI1		1
17	STOP	ENABLE	FB REF	P-23 REF	Fire Mode		Analog Input AI1		1
18	STOP	ENABLE	AI1 REF	FB REF	Fire Mode		Analog Input AI1		1
2,4,8,9,10,11,12,13 = 0									

Note:

- When P-31 = 0, 1, 4 or 5:
  - Digital Input 1 must be closed to allow the drive to operate.
  - Start and Stop Commands are through the selected fieldbus interface dependent on P-12 setting.
  - In Slave Mode (P-12 = 9), Start and Stop control is always determined by the Master drive operating status regardless of P-31 setting
- When P-31=2, 3, 6 or 7:
  - Start / Stop operation is controlled by Digital Input 1.
  - Communication loss trip action for Modbus RTU is disabled.
- In addition, the following applies:
  - P-15 = 5: When the Preset Speeds are selected as the speed reference (e.g. Digital Input 2 is ON):
    - Communication loss trip is disabled
    - Start / Stop operation is by Digital Input 1.
  - P-15 = 6: When Analog Input 1 is selected as the speed reference (e.g. Digital Input 2 is ON):
    - Communication loss trip is disabled.
    - Start / Stop operation is by Digital Input 1.
  - P-15 = 7: When the Keypad is selected as the speed reference (e.g. Digital Input 2 is ON):
    - Communication loss trip is disabled.
    - Start / Stop operation is by Digital Input 1.
- Communication loss control is always disabled when fire mode is active.
- For information on the External Trip (E-TRIP↴) and motor thermistor monitoring function, see section 6.7 Motor Thermistor Connection.
- Fire Mode input logic (Normally Open or Normally Closed) and latching mode are selected by P-30. When the input mode is set to latched, the enable signal must be removed to reset the latch.

8.3.4. Macro Functions - User PI Control Mode (P-12 = 5 or 6)

P-15	DI1		DI2		DI3 / AI2		DI4 / AI1		Diagram
	0	1	0	1	0	1	0	1	
0	STOP	ENABLE	PI REF	P-20 REF	Analog Input AI2		Analog Input AI1		4
1	STOP	ENABLE	PI REF	AI1 REF	Analog Input AI2 (PI FB)		Analog Input AI1		4
3, 7	STOP	ENABLE	PI REF	P-20	E-TRIP ↴	(NC)	Analog Input AI1 (PI FB)		3
4	(NO)	START ↥	(NC)	STOP ↴	Analog Input AI2 (PI FB)		Analog Input AI1		12
5	(NO)	START ↥	(NC)	STOP ↴	PI REF	P-20 REF	Analog Input AI1 (PI FB)		5
6	(NO)	START ↥	(NC)	STOP ↴	E-TRIP ↴	(NC)	Analog Input AI1 (PI FB)		
8	STOP	RUN	FWD ↻	REV ↺	Analog Input AI2 (PI FB)		Analog Input AI1		4
14	STOP	RUN	-	-	E-TRIP ↴	(NC)	Analog Input AI1 (PI FB)		16
15	STOP	RUN	P-23 REF	PI REF	Fire Mode		Analog Input AI1 (PI FB)		1
16	STOP	RUN	P-23 REF	P-21 REF	Fire Mode		Analog Input AI1 (PI FB)		1
17	STOP	RUN	P-21 REF	P-23 REF	Fire Mode		Analog Input AI1 (PI FB)		1
18	STOP	RUN	AI1 REF	PI REF	Fire Mode		Analog Input AI1		1
2,9,10,11,12,13 = 0									

- For information on the External Trip (E-TRIP↴) and motor thermistor monitoring function, see section 6.7 Motor Thermistor Connection.
- Fire Mode input logic (Normally Open or Normally Closed) and latching mode are selected by P-30. When the input mode is set to latched, the enable signal must be removed to reset the latch.

8.4. Example Connection Diagrams

Diagram 1

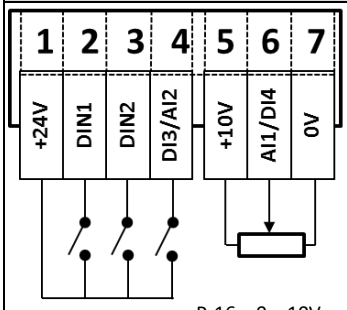


Diagram 2

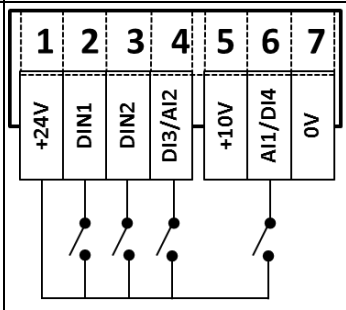


Diagram 3

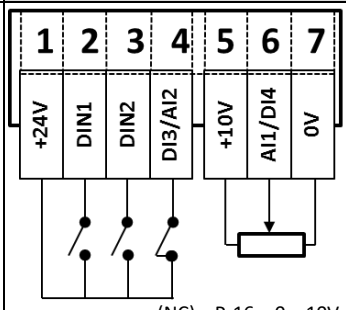


Diagram 4

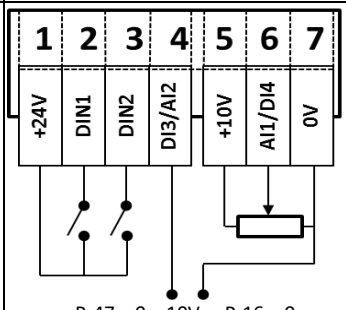


Diagram 5

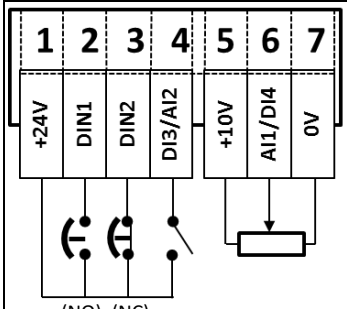


Diagram 6

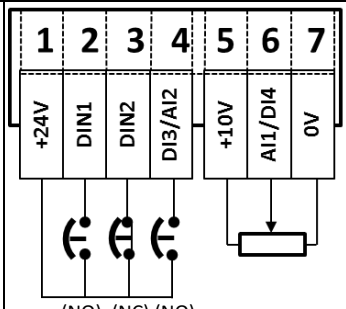


Diagram 7

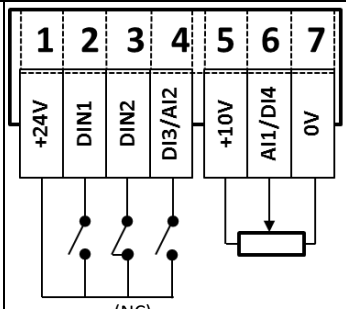


Diagram 8

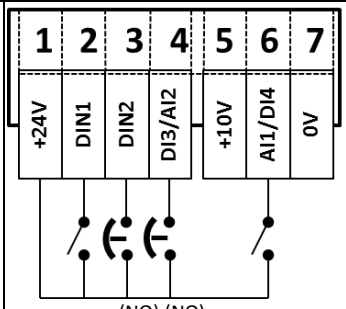


Diagram 9

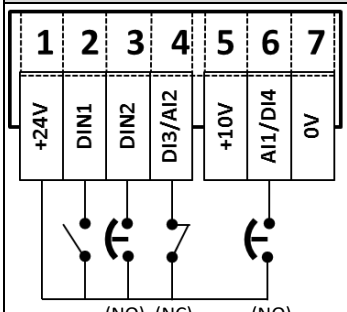


Diagram 10

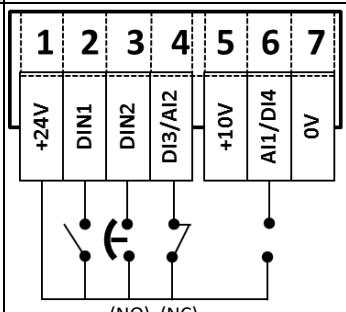


Diagram 11

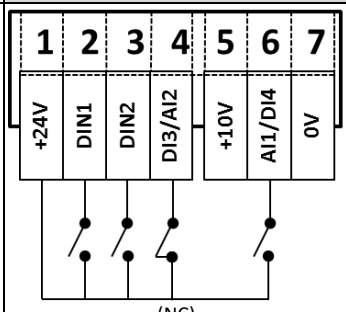


Diagram 12

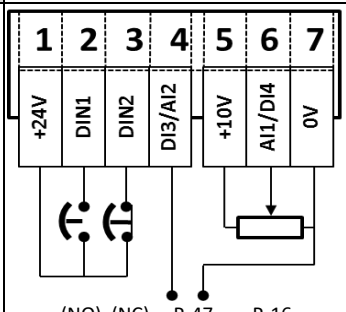


Diagram 13

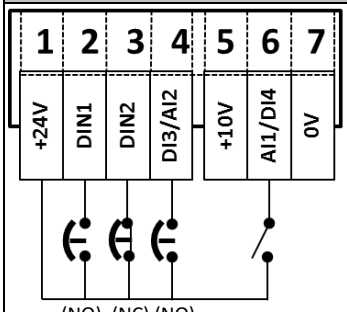


Diagram 14

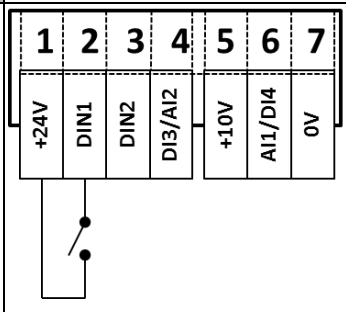


Diagram 15

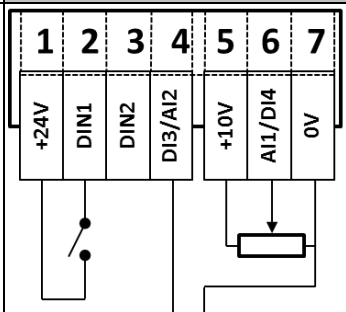
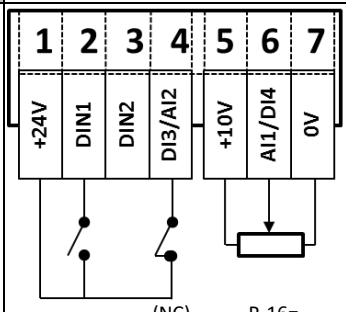


Diagram 16



8.5. Software Functions

8.5.1. Fire Mode

The Fire Mode function is designed to ensure continuous operation of the drive in emergency conditions until the drive is no longer capable of sustaining operation. The Fire Mode input may be a normally open (Close to Activate Fire Mode) or Normally Closed (Open to Activate Fire Mode) according to the setting of P-30 Index 2. In addition, the input may be momentary or maintained type, selected by P-30 Index 3.
This input may be linked to a fire control system to allow maintained operation in emergency conditions, e.g. to clear smoke or maintain air quality within that building.
The fire mode function is enabled when P-15 = 15, 16 or 17, with Digital Input 3 assigned to activate fire mode.
Fire Mode disables the following protection features in the drive: -

- O-t Heat-sink Over-Temperature
- U-t Drive Under Temperature
- Th-FLt Faulty Thermistor on Heat-sink
- E-trip External Trip
- 4-20 F 4-20mA fault
- Ph-Ib Phase Imbalance
- P-Loss Input Phase Loss Trip
- SC-trp Communications Loss Trip
- It-trp Accumulated overload Trip
- Out-F Drive output fault, Output stage trip

The following faults will result in a drive trip, auto reset and restart: -

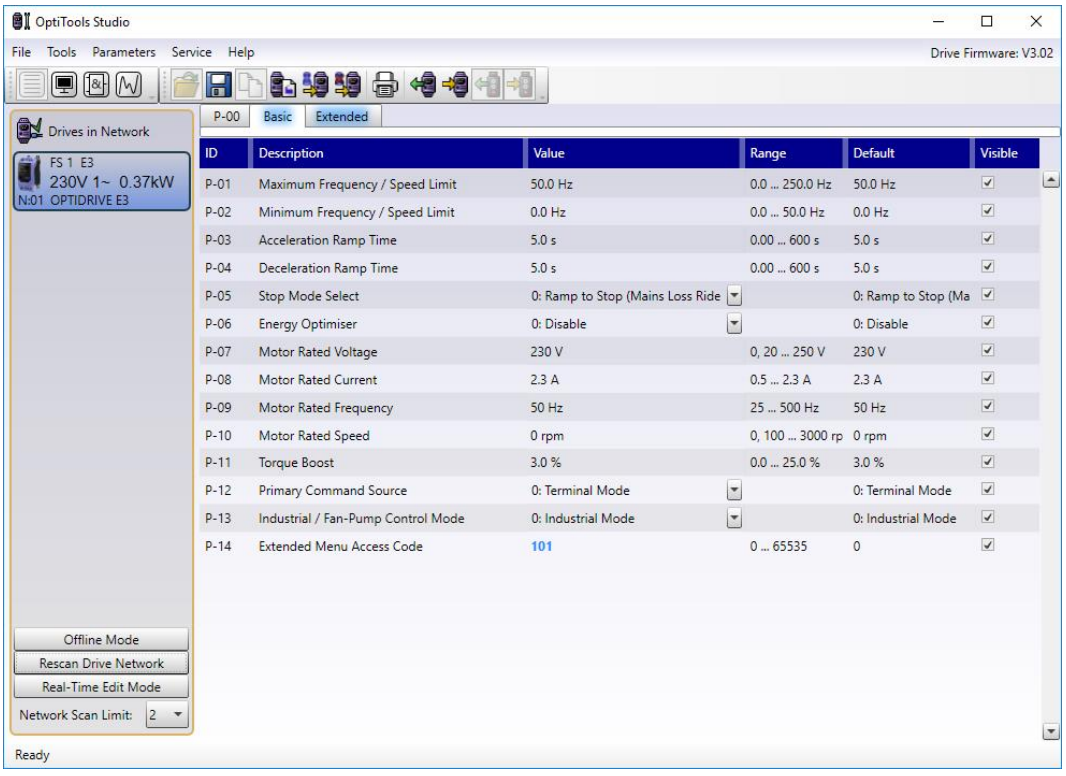
- O-Volt Over Voltage on DC Bus
- U-Volt Under Voltage on DC Bus
- h O-I Fast Over-current Trip
- O-I Instantaneous over current on drive output

8.5.2. OEM / User Default Parameters

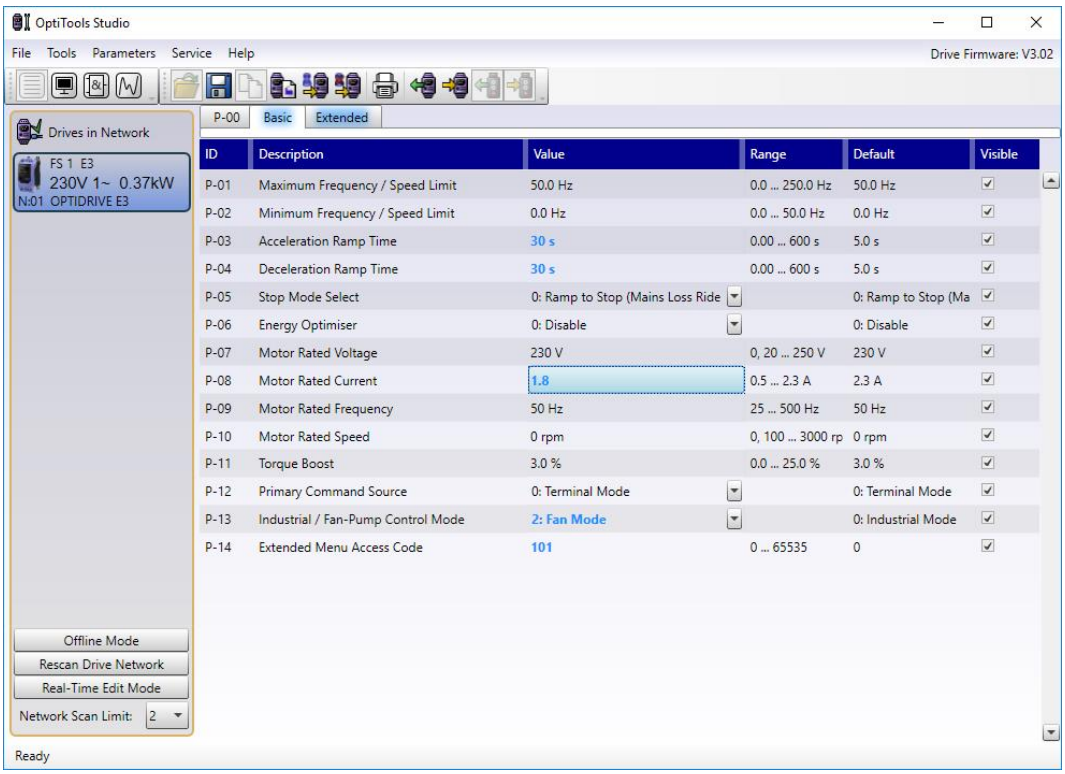
Optidrive Compact 2 includes an embedded function to allow the user to create their own “default” parameters. This means that if a factory reset is carried out, the drive will return to these parameters, as opposed to the Invertek Drive factory default parameters.
This feature is accessed using Optitools Studio PC software only, which may be freely downloaded from the Invertek Drives website.

Creating the default parameter set

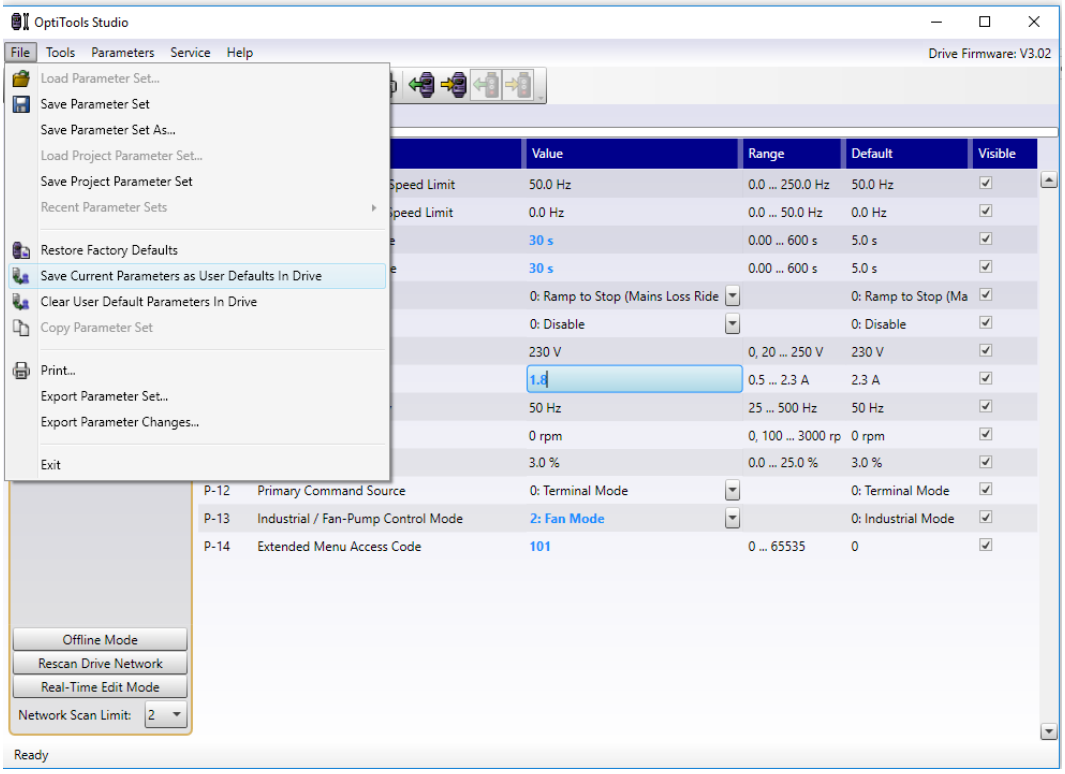
In order to create the User Default settings, the following process should be used.



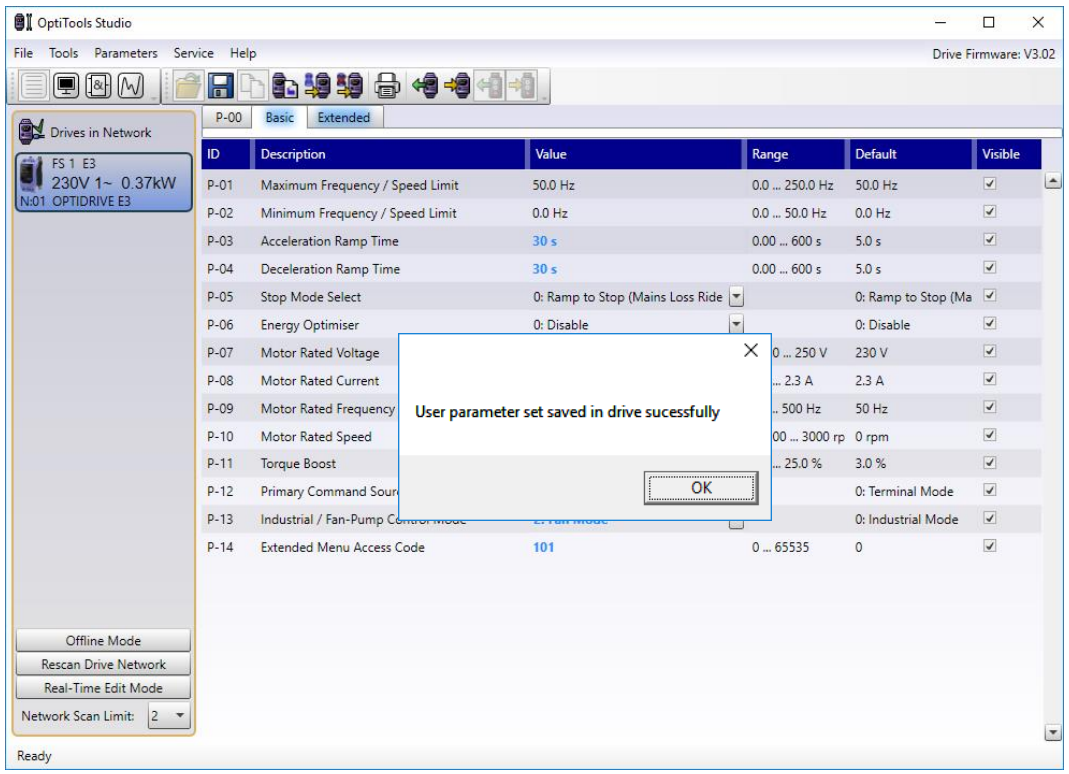
In Optitools Studio, ensure communication is established with the connected drive.



Make any changes to the parameter set as required. Changes from Invertek factory default settings are highlighted in blue.



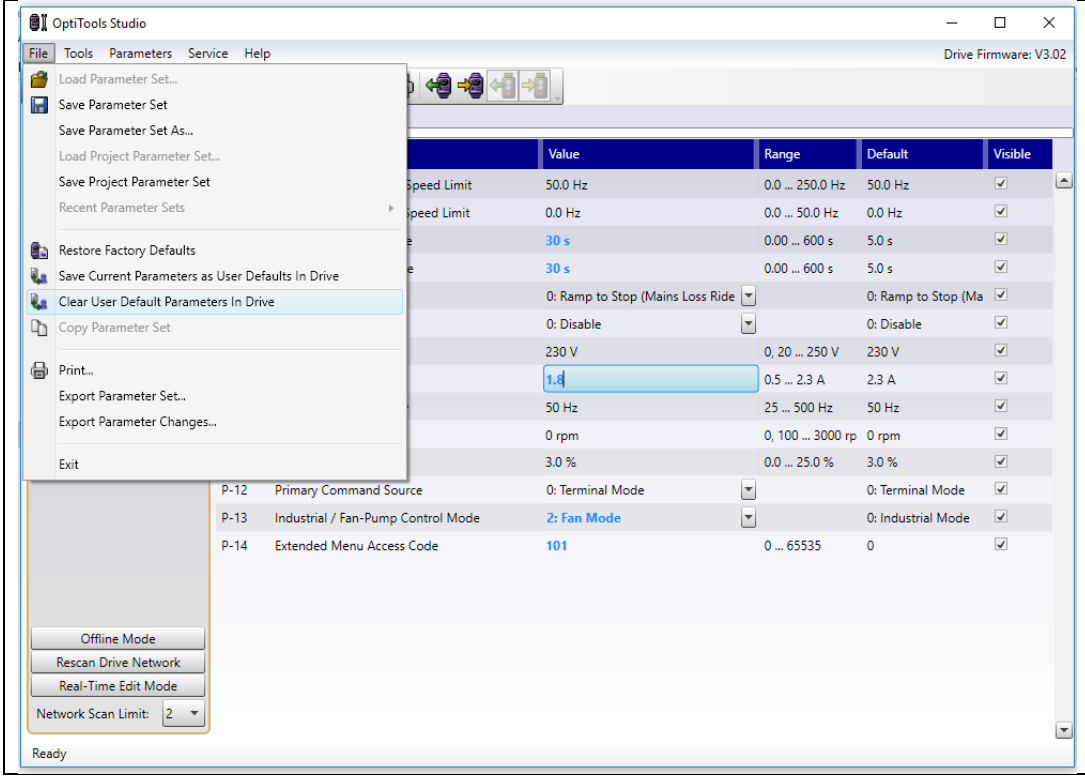
In the File menu, select “Save Current Parameters as User Defaults in Drive”



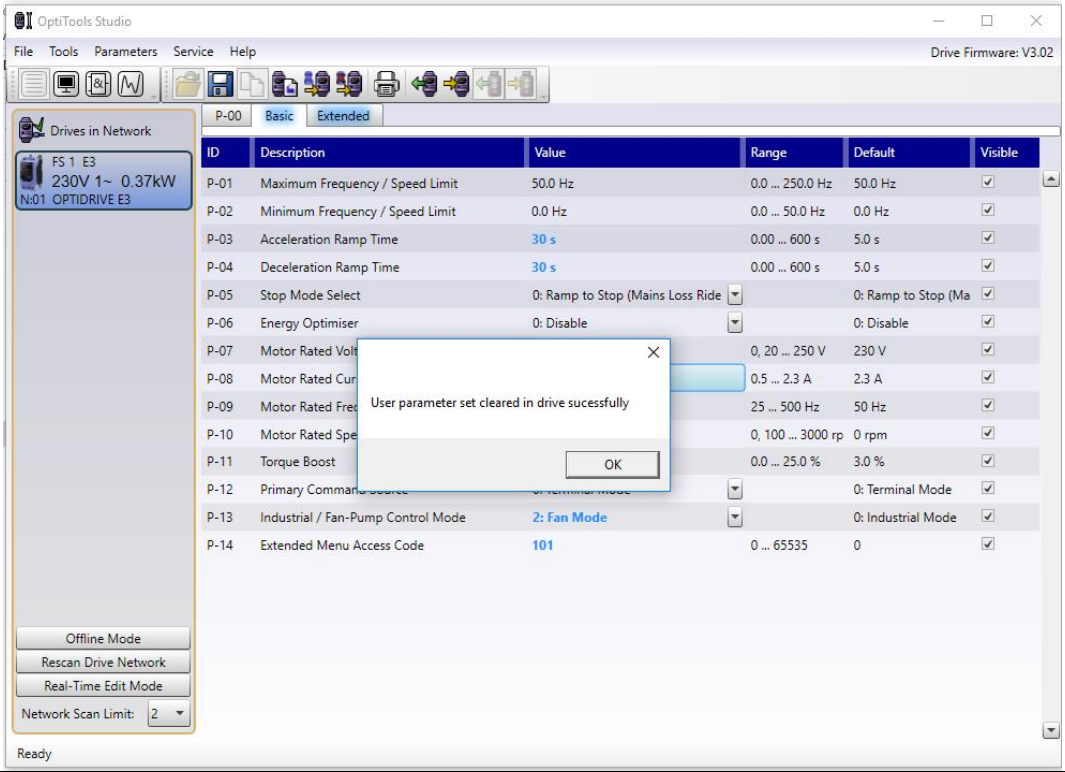
The confirmation message will appear.

Clearing User Default Parameters

In order to clear the User Default parameters, the following method is used.



From the File menu, select “Clear User Default Parameters in Drive”



The confirmation message will appear to show the user defaults are now cleared and resetting the drive will return it to Invertek Drives Factory default settings.

9. Serial Communications

9.1. Overview

OPC-2-CON-E-IN provides support for the following fieldbus networks and functions: -

Fieldbus	Interface	Availability	Drive Control	Drive Parameter Access
Modbus RTU	On-board RJ45	From Launch	Yes	Access to all Writable Parameters
CAN bus	On-board RJ45	From Launch	Yes	Access to all Writable Parameters

9.2. Modbus RTU

OPC-2-CON-E-IN supports Modbus RTU communication, using the 03 Read Holding Registers and 06 Write Single Holding Register commands. In addition, Control Registers 1 – 4 may be written to using the 16 Write Multiple Holding Registers. Many Master devices treat the first Register address as Register 0; therefore, it may be necessary to convert the register numbers listed below by subtracting 1 to obtain the correct Register address. The telegram structure is as follows: -

Command 03 – Read Holding Registers						
Master Telegram	Length			Slave Response	Length	
Slave Address	1	Byte		Slave Address	1	Byte
Function Code (03)	1	Byte		Starting Address	1	Byte
1st Register Address	2	Bytes		1st Register Value	2	Bytes
No. Of Registers	2	Bytes		2nd Register Value	2	Bytes
CRC Checksum	2	Bytes		Etc...		
				CRC Checksum	2	Bytes

Command 06 – Write Single Holding Register						
Master Telegram	Length			Slave Response	Length	
Slave Address	1	Byte		Slave Address	1	Byte
Function Code (06)	1	Byte		Function Code (06)	1	Byte
Register Address	2	Bytes		Register Address	2	Bytes
Value	2	Bytes		Register Value	2	Bytes
CRC Checksum	2	Bytes		CRC Checksum	2	Bytes

The table shows the Modbus RTU register number corresponding to each parameter value. All values are holding registers.
All User Adjustable parameters are accessible by Modbus. Note that changing any parameters which affect the communication interface will result in a loss of communication.
All parameter values can be read from the drive and written to, depending on the operating mode of the drive – for example some parameters cannot be changed whilst the drive is enabled.

9.3. CAN

The CAN communication profile in the OPC-2-CON-E-IN is implemented according to the specification DS301 version 4.02 of CAN in automation (www.can-cia.de). Specific device profiles such as DS402 are not supported.
The CAN communication function is enabled by default after power up. However, in order to use any control functions through CAN, this requires P-12 = 7 or 8.
The CAN communication baud rate can be set by using parameter P-36. Available baud rates are: 125kbps, 250kbps, 500kbps, 1Mbps. (with default settings as 500kbps).
The Node ID is set up through drive address parameter P-36 as well with the default value of 1.
The tables below show the Index and Sub Index required to address each parameter. All User Adjustable parameters are accessible by CAN, except those that would directly affect the communications.
All parameter values can be read from the drive and written to, depending on the operating mode of the drive – some parameters may be changed whilst the drive is enabled for example.
Optidrive Compact 2 provides the following default COB-ID and functions:

Type	COB-ID	Function
NMT	000h	Network management
Sync	080h	Synchronous message COB-ID can be configured to other value.
Emergency	080h + Node address	Emergency message
PDO1 (TX)	180h + Node address	Process data object. PDO1 is pre-mapped and enabled by default. COB-ID can be configured to other value. PDO2 is pre-mapped and disabled by default. Transmission mode, COB-ID and mapping can be configured.
PDO1 (RX)	200h + Node address	
PDO2 (TX)	280h + Node address	
PDO2 (RX)	300h + Node address	
SDO (TX)	580h + Node address	SDO channel can be used for drive parameter access.
SDO (RX)	600h + Node address	
Error Control	700h + Node address	Guarding and Heartbeat function are supported. COB-ID can be configured to other value.

Note

- The OPC-2-CON-E-IN SDO channel only supports expedited transmission.
- The OPC-2-CON-E-IN can only support up to 2 Process Data Objects (PDO). All PDOs are pre-mapped; however, PDO2 is disabled by default. The table below gives the default PDO mapping information.
- Customer configuration (mapping) will NOT be saved during power down. This means that the CAN configuration will restore to its default condition each time the drive is powered up.

9.3.1. PDO Default Mapping

	Objects No.	Mapped Object	Length	Mapped Function	Transmission Type
RX PDO1	1	2000h	Unsigned 16	Control command register*	254 Valid immediately
	2	2001h	Integer 16	Speed reference	
	3	2003h	Unsigned 16	User ramp reference	
	4	0006h	Unsigned 16	Dummy	
TX PDO1	1	200Ah	Unsigned 16	Drive status register	254 Send after receiving RX PDO 1
	2	200Bh	Integer 16	Motor speed Hz	
	3	200Dh	Unsigned 16	Motor current	
	4	2010h	Integer 16	Drive temperature	
RX PDO2	1	0006h	Unsigned 16	Dummy	254
	2	0006h	Unsigned 16	Dummy	
	3	0006h	Unsigned 16	Dummy	
	4	0006h	Unsigned 16	Dummy	
TX PDO2	1	2011h	Unsigned 16	DC bus voltage	254
	2	2012h	Unsigned 16	Digital input status	
	3	2013h	Integer 16	Analog input 1 (%)	
	4	2014h	Integer 16	Analog input 2 (%)	

***** Drive control can only be achieved when P-12=7 or 8 provided that P-31 = 0, 1, 4 or 5.

9.3.2. PDO transmission type

Various transmission modes can be selected for each PDO. For RX PDO, the following modes are supported: -

Transmission Type	Mode	Description
0 – 240	Synchronous	The received data will be transferred to the drive active control register when the next sync message is received.
254, 255	Asynchronous	The received data will be transferred to the drive active control register immediately without delay.

For TX PDO, the following modes are supported: -

Transmission Type	Mode	Description
0	Acyclic synchronous	TX PDO will only be sent out if the PDO data has changed and PDO will be transmitted on reception of SYNC object
1-240	Cyclic synchronous	TX PDO will be transmitted synchronously and cyclically. The transmission type indicates the number of SYNC object that are
254	Asynchronous	TX PDO will only be transferred once corresponding RX PDO has been received.
255	Asynchronous	TX PDO will only be transferred anytime if PDO data value has changed.

9.3.3. CAN Specific Object Table

Index	Sub Index	Function	Access	Type	PDO Map	Default Value
1000h	0	Device Type	R	U32	N	0
1001h	0	Error Register	R	U8	N	0
1002h	0	Manufacturer Status Register	R	U16	N	0
1005h	0	COB-ID Sync	RW	U32	N	00000080h
1008h	0	Manufacturer Device Name	R	String	N	
1009h	0	Manufacturer Hardware Version	R	String	N	x.xx
100Ah	0	Manufacturer Software Version	R	String	N	x.xx
100Ch	0	Guard Time (1ms)	RW	U16	N	0
100Dh	0	Life Time Factor	RW	U8	N	0
1014h	0	COB-ID EMCY	RW	U32	N	00000080h+Node ID
1015h	0	Inhibit Time Emergency (100µs)	RW	U16	N	0
1017h	0	Producer Heartbeat Time (1ms)	RW	U16	N	0
1018h	0	Identity Object No. Of entries	R	U8	N	4
	1	Vendor ID	R	U32	N	0x0000031A
	2	Product Code	R	U32	N	Drive Dependent
	3	Revision Number	R	U32	N	x.xx
	4	Serial Number	R	U32	N	Drive Dependent
1200h	0	SDO Parameter No. Of entries	R	U8	N	2
	1	COB-ID Client -> Server (RX)	R	U32	N	00000600h+Node ID
	2	COB-ID Server -> Client (TX)	R	U32	N	00000580h+Node ID
1400h	0	RX PDO1 comms param. no. of entries	R	U8	N	2
	1	RX PDO1 COB-ID	RW	U32	N	40000200h+Node ID
	2	RX PDO transmission type	RW	U32	N	254
1401h	0	RX PDO2 comms param. no. of entries	R	U8	N	2
	1	RX PDO2 COB-ID	RW	U32	N	C0000300h+Node ID
	2	RX PDO2 transmission type	RW	U8	N	0
1600h	0	RX PDO1 1 mapping / no. of entries	RW	U8	N	4
	1	RX PDO1 1st mapped object	RW	U32	N	20000010h
	2	RX PDO1 2nd mapped object	RW	U32	N	20010010h
	3	RX PDO1 3rd mapped object	RW	U32	N	20030010h
	4	RX PDO1 4th mapped object	RW	U32	N	00060010h
1601h	0	RX PDO2 1 mapping / no. of entries	RW	U8	N	4
	1	RX PDO2 1st mapped object	RW	U32	N	00060010h
	2	RX PDO2 2nd mapped object	RW	U32	N	00060010h
	3	RX PDO2 3rd mapped object	RW	U32	N	00060010h
	4	RX PDO2 4th mapped object	RW	U32	N	00060010h
1800h	0	TX PDO1 comms parameter number of entries	R	U8	N	3
	1	TX PDO1 COB-ID	RW	U32	N	40000180h+Node ID
	2	TX PDO1 transmission type	RW	U8	N	254
	3	TX PDO1 Inhibit time (100µs)	RW	U16	N	0
1801h	0	TX PDO2 comms parameter no. of entries	R	U8	N	3
	1	TX PDO2 COB-ID	RW	U32	N	C0000280h+Node ID
	2	TX PDO2 transmission type	RW	U8	N	0
	3	TX PDO2 Inhibit time (100µs)	RW	U16	N	0
1A00h	0	TX PDO1 mapping / no. of entries	RW	U8	N	4
	1	TX PDO1 1st mapped object	RW	U32	N	200A0010h
	2	TX PDO1 2nd mapped object	RW	U32	N	200B0010h
	3	TX PDO1 3rd mapped object	RW	U32	N	200D0010h
	4	TX PDO1 4th mapped object	RW	U32	N	20100010h
1A01h	0	TX PDO2 mapping / no. of entries	RW	U8	N	4
	1	TX PDO2 1st mapped object	RW	U32	N	20110010h
	2	TX PDO2 2nd mapped object	RW	U32	N	20120010h
	3	TX PDO2 3rd mapped object	RW	U32	N	20130010h
	4	TX PDO2 4th mapped object	RW	U32	N	20140010h

9.3.4. Parameter Access Overview

The accessible parameter numbers and respective scaling are listed in the following tables. The method to access the parameters depends on the fieldbus type in use as described in the following section.
The R/W column indicates whether the values are Writeable as well as readable (R/W) or Read Only (R)
The data types for the parameter are defined as follows: -

WORD Hexadecimal Word
U16 Unsigned 16 Bit Value
S16 Signed 16 Bit Value

9.3.5. Modbus RTU Register / CAN Index Data – Control & Monitoring

Modbus RTU Register	CAN Open Index	Sub Index	PDO Map	Parameter Number	Upper byte	Lower Byte	Format	Min	Max	Type	Scaling
1	2000h	0	Y	-	Control Word		WORD	-	-	R/W	See Below
2	2001h	0	Y	-	Frequency Setpoint		S16	-5000	5000	R/W	1dp, e.g. 100 = 10.0Hz
3	2002h	0	Y	-	Reserved		-	-	-	R/W	No function
4	2003h	0	Y	-	Modbus ramp control time		U16	0	60000	R/W	2dp, e.g. 500 = 5.00s
5	2004h	0	Y	-	High Resolution Frequency Setpoint		S16	-30000	30000	R	See Below
6	200Ah	0	Y	-	Error code	Drive status	WORD	-	-	R	See Below
7	200Bh	0	Y	-	Output Frequency		S16	0	5000	R	1dp, e.g. 100 = 10.0Hz
8	200Dh	0	Y	-	Motor Current		U16	0	-	R	1dp, e.g. 100 = 10.0A
9	200Eh	0	Y	-	Motor Torque		S16	0	2000	R	1dp, e.g. 100 = 10.0%
10	200Fh	0	Y	-	Motor Power		U16	0	-	R	2dp, e.g. 100 = 1.00kW
11	2012h	0	Y	P00-04	Digital Input Status		WORD	-	-	R	See Below
12	-	-		P00-20	Rating ID		U16	-	-	R	Internal Value
13	-	-		P00-20	Power rating		U16	-	-	R	2dp, e.g. 37 = 0.37kW / HP
14	-	-		P00-20	Voltage rating		U16	-	-	R	See Below
15	27E8h	0	N	P00-18	IO processor software version		U16	-	-	R	2dp, e.g. 300 = 3.00
16	27EAh	0	N	P00-18	Motor control processor software version		U16	-	-	R	2dp, e.g. 300 = 3.00
17	-	-		P00-20	Drive type		U16	-	-	R	Internal Value
18	201Ch	0	Y	P00-48	Scope Channel 1 Data		S16	-	-	R	Internal Format
19	201Dh	0	Y	P00-48	Scope Channel 2 Data		S16	-	-	R	Internal Format
-	201Eh	0	Y	P00-49	Scope Channel 3 Data		S16			R	Internal Format
-	201Fh	0	Y	P00-49	Scope Channel 4 Data		S16			R	Internal Format
20	2013h	0	Y	P00-01	Analog 1 input result		U16	0	1000	R	1dp, e.g. 500 = 50.0%
21	2014h	0	Y	P00-02	Analog 2 input result		U16	0	1000	R	1dp, e.g. 500 = 50.0%
-	2015h	0	Y	-	Analog Output %		U16	0	1000	R	1dp, e.g. 500 = 50.0%
22	-	-		P00-03	Pre-Ramp Speed Reference Value		S16	0	5000	R	1dp, e.g. 500 = 50.0Hz
23	2011h	0	Y	P00-08	DC Bus Voltage		U16	0	1000	R	600 = 600 Volts
24	-			P00-09	Drive Power Stage Temperature		S16	-10	150	R	50 = 50°C
-	2043h	0	Y	-	Control board temperature		S16	-10	150	R	50 = 50°C
25	-	-		P00-30	Drive Serial Number 4		U16	-	-	R	See Below
26	-	-		P00-30	Drive Serial Number 3		U16	-	-	R	
27	-	-		P00-30	Drive Serial Number 2		U16	-	-	R	
28	-	-		P00-30	Drive Serial Number 1		U16	-	-	R	
29	2017h	0	Y	-	Relay Output Status		WORD	0	1	R	Bit 0 Indicates Relay Status 1 = Relay Contacts Closed
30	-	-		-	Reserved		-	-	-	R	No Function
31	-	-		-	Reserved		-	-	-	R	No Function
32	203Ch	0	Y	P00-26	kWh Meter		U16	0	9999	R	1dp, e.g. 100 = 10.0kWh
33	203Dh	0	Y	P00-26	MWh Meter		U16	0		R	10 = 10MWh
34	203Eh	0	Y	P00-10	Running Time – Hours		U16			R	1 = 1 Hour
35	203Fh	0	Y	P00-10	Running Time – Minutes & Seconds		U16			R	100 = 100 Seconds
36	2040h	0	Y	P00-14	Run time since last enable – Hours		U16			R	1 = 1 Hour
37	2041h	0	Y	P00-14	Run time since last enable – Minutes & seconds		U16			R	100 = 100 Seconds
38	-	-		-	Reserved		U16			R	No Function
39	2010h	0	Y	P00-20	Internal Drive Temperature		S16	-10	100	R	20 = 20C
40	2044h	0	Y	-	Speed Reference (Internal Format)		U16	0	P-01	R	3000 = 50Hz
41	-	-		-	Reserved		-	-	-	R	No Function
42	2046h	0	Y		Digital Pot / Keypad Reference		U16	0	P-01	R	3000 = 50Hz
43	2048h	0	Y	P00-07	Output Voltage		U16	0	-	R	100 = 100 Volts AC RMS
44	-	-		-	Parameter Access Index		U16	1	60	R	See Below
45	-	-		-	Parameter Access Value		S16	-	-	R	See Below
-	2049h	0	Y	P00-05	PI Output		U16	0	1000	R	1000 = 100.0%
-	23E8h	0	N	-	Scope Index 12					RW	
-	23E9h	0	N	-	Scope Index 34					RW	
-	27D0h	0	N	P00-11	Run Time Since Last Trip 1 – Hours		U16	0	65535	R	1 = 1 Hour
-	27D1h	0	N	P00-11	Run Time Since Last Trip 1 - Seconds		U16	0	3599	R	100 = 100 Seconds
-	27D2h	0	N	P00-12	Run Time Since Last Trip 2 – Hours		U16	0	65535	R	1 = 1 Hour
-	27D3h	0	N	P00-12	Run Time Since Last Trip 2 - Seconds		U16	0	3599	R	100 = 100 Seconds
-	27D4h	0	N	P00-13	Trip Log 2 & 1		WORD	-	-	R	
-	27D5h	0	N	P00-13	Trip Log 4 & 3		WORD	-	-	R	
-	27D6h	0	N	P00-13	Trip 1 Time – Hours		U16	0	65535	R	1 = 1 Hour

Modbus RTU Register	CAN Open Index	Sub Index	PDO Map	Parameter Number	Upper byte	Lower Byte	Format	Min	Max	Type	Scaling
-	26D7h	0	N	P00-13	Trip 1 Time - Seconds		U16	0	3599	R	100 = 100 Seconds
-	27D8h	0	N	P00-13	Trip 2 Time – Hours		U16	0	65535	R	1 = 1 Hour
-	27D9h	0	N	P00-13	Trip 2 Time - Seconds		U16	0	3599	R	100 = 100 Seconds
-	27DAh	0	N	P00-13	Trip 3 Time – Hours		U16	0	65535	R	1 = 1 Hour
-	27DBh	0	N	P00-13	Trip 3 Time - Seconds		U16	0	3599	R	100 = 100 Seconds
-	27DCh	0	N	P00-13	Trip 4 Time – Hours		U16	0	65535	R	1 = 1 Hour
-	27DDh	0	N	P00-13	Trip 4 Time - Seconds		U16	0	3599	R	100 = 100 Seconds
-	27DEh	0	N	P00-23	Time Heatsink > 85°C – Hours		U16	0	65535	R	1 = 1 Hour
-	27DFh	0	N	P00-23	Time Heatsink > 85°C - Seconds		U16	0	3599	R	100 = 100 Seconds
-	27E0h	0	N	P00-24	Time Internal > 80°C – Hours		U16	0	65535	R	1 = 1 Hour
-	27E1h	0	N	P00-24	Time Internal > 80°C - Seconds		U16	0	3599	R	100 = 100 Seconds
-	27E2h	0	N	P00-27	Fan Run Time – Hours		U16	0	65535	R	1 = 1 Hour
-	27E3h	0	N	P00-27	Fan Run Time - Seconds		U16	0	3599	R	100 = 100 Seconds
-	27E4h	0	N	-	Fire Mode Active Time – Hours		U16	0	65535	R	1 = 1 Hour
-	27E5h	0	N	-	Fire Mode Active Time - Seconds		U16	0	3599	R	100 = 100 Seconds
-	27E6h	0	N	-	Power On Time – Hours		U16	0	65535	R	1 = 1 Hour
-	27E7h	0	N	-	Power On Time - Seconds		U16	0	3599	R	100 = 100 Seconds
-	27E9h	0	N	P00-28	IO Checksum		WORD	-	-	R	
-	27EBh	0	N	P00-28	DSP Checksum		WORD	-	-	R	
-	27ECh	0	N	P00-19	Ambient Temperature Log 1		S16	-10	150	R	50 = 50°C
-	27Edh	0	N	P00-19	Ambient Temperature Log 2		S16	-10	150	R	50 = 50°C
-	27EEh	0	N	P00-19	Ambient Temperature Log 3		S16	-10	150	R	50 = 50°C
-	27EFh	0	N	P00-19	Ambient Temperature Log 4		S16	-10	150	R	50 = 50°C
-	27F0h	0	N	P00-19	Ambient Temperature Log 5		S16	-10	150	R	50 = 50°C
-	27F1h	0	N	P00-19	Ambient Temperature Log 6		S16	-10	150	R	50 = 50°C
-	27F2h	0	N	P00-19	Ambient Temperature Log 7		S16	-10	150	R	50 = 50°C
-	27F3h	0	N	P00-19	Ambient Temperature Log 8		S16	-10	150	R	50 = 50°C
-	27F4h	0	N	P00-15	DC Bus Voltage Log 1		U16	0	1000	R	600 = 600 Volts
-	27F5h	0	N	P00-15	DC Bus Voltage Log 2		U16	0	1000	R	600 = 600 Volts
-	27F6h	0	N	P00-15	DC Bus Voltage Log 3		U16	0	1000	R	600 = 600 Volts
-	27F7h	0	N	P00-15	DC Bus Voltage Log 4		U16	0	1000	R	600 = 600 Volts
-	27F8h	0	N	P00-15	DC Bus Voltage Log 5		U16	0	1000	R	600 = 600 Volts
-	27F9h	0	N	P00-15	DC Bus Voltage Log 6		U16	0	1000	R	600 = 600 Volts
-	27FAh	0	N	P00-15	DC Bus Voltage Log 7		U16	0	1000	R	600 = 600 Volts
-	27FBh	0	N	P00-15	DC Bus Voltage Log 8		U16	0	1000	R	600 = 600 Volts
-	27FCh	0	N	P00-16	Heatsink Temperature Log 1		S16	-10	150	R	50 = 50°C
-	27FDh	0	N	P00-16	Heatsink Temperature Log 2		S16	-10	150	R	50 = 50°C
-	27FEh	0	N	P00-16	Heatsink Temperature Log 3		S16	-10	150	R	50 = 50°C
-	27FFh	0	N	P00-16	Heatsink Temperature Log 4		S16	-10	150	R	50 = 50°C
-	2800h	0	N	P00-16	Heatsink Temperature Log 5		S16	-10	150	R	50 = 50°C
-	2801h	0	N	P00-16	Heatsink Temperature Log 6		S16	-10	150	R	50 = 50°C
-	2802h	0	N	P00-16	Heatsink Temperature Log 7		S16	-10	150	R	50 = 50°C
-	2803h	0	N	P00-16	Heatsink Temperature Log 8		S16	-10	150	R	50 = 50°C
-	2804h	0	N	P00-17	Motor Current Log 1		U16	0	-	R	1dp, e.g. 100 = 10.0A
-	2805h	0	N	P00-17	Motor Current Log 2		U16	0	-	R	1dp, e.g. 100 = 10.0A
-	2806h	0	N	P00-17	Motor Current Log 3		U16	0	-	R	1dp, e.g. 100 = 10.0A
-	2807h	0	N	P00-17	Motor Current Log 4		U16	0	-	R	1dp, e.g. 100 = 10.0A
-	2808h	0	N	P00-17	Motor Current Log 5		U16	0	-	R	1dp, e.g. 100 = 10.0A
-	2809h	0	N	P00-17	Motor Current Log 6		U16	0	-	R	1dp, e.g. 100 = 10.0A
-	280Ah	0	N	P00-17	Motor Current Log 7		U16	0	-	R	1dp, e.g. 100 = 10.0A
-	280Bh	0	N	P00-17	Motor Current Log 8		U16	0	-	R	1dp, e.g. 100 = 10.0A
-	280Ch	0	N	P00-18	DC Ripple Log 1		U16	0	-	R	1 = 1 Volt
-	280Dh	0	N	P00-18	DC Ripple Log 2		U16	0	-	R	1 = 1 Volt
	280Eh	0	N	P00-18	DC Ripple Log 3		U16	0	-	R	1 = 1 Volt
-	280Fh	0	N	P00-18	DC Ripple Log 4		U16	0	-	R	1 = 1 Volt
-	2810h	0	N	P00-18	DC Ripple Log 5		U16	0	-	R	1 = 1 Volt
-	2811h	0	N	P00-18	DC Ripple Log 6		U16	0	-	R	1 = 1 Volt
-	2812h	0	N	P00-18	DC Ripple Log 7		U16	0	-	R	1 = 1 Volt
-	2813h	0	N	P00-18	DC Ripple Log 8		U16	0	-	R	1 = 1 Volt
-	2814h	0	N	P00-25	Estimated Rotor Speed		S16	-	-	R	
-	2815h	0	N	P00-32	Actual PWM Frequency		U16	-	-	R	
-	2816h	0	N	P00-31	Motor Current iD		U16	0	-	R	
-	2817h	0	N	P00-31	Motor Current iQ		U16	0	-	R	
-	2818h	0	N	P00-33	O-I Trip Counter		U16	0	-	R	
-	2819h	0	N	P00-34	O-V Trip Counter		U16	0	-	R	
-	281Ah	0	N	P00-35	U-V Trip Counter		U16	0	-	R	
-	281Bh	0	N	P00-36	O-T Trip Counter		U16	0	-	R	
-	281Ch	0	N	P00-37	bO-I Trip Counter		U16	0	-	R	
-	281Dh	0	N	P00-38	O-Heat Trip Counter		U16	0	-	R	

9.3.6. Modbus RTU / CAN Index – Parameters

Modbus RTU Register	CAN Open Index	Par.	Description	Format	Min	Max	Data format / scaling
129	2065h	01	Max speed limit	U16	0	5*P-09	Internal value (3000 = 50.0Hz)
130	2066h	02	Min speed limit	U16	0	P-01	Internal value (3000 = 50.0Hz)
131	2067h	03	Accel ramp time	U16	0	60000	2dp, e.g. 300=30.0s
132	2068h	04	Decel ramp time	U16	0	60000	2dp, e.g. 300=30.0s
133	2069h	05	Stop Mode	U16	0	3	See parameter description for details
134	206Ah	06	Energy Optimiser	U16	0	1	See parameter description for details
135	206Bh	07	Motor rated voltage	U16	0	250 500	400 = 400 Volts
136	206Ch	08	Motor rated current	U16	0	Drive Rating Dependent	1dp, e.g. 100 = 10.0A
137	206Dh	09	Motor rated frequency	U16	25	500	Data unit is in Hz
138	206Eh	10	Motor rated speed	U16	0	30000	Maximum value equals to the sync speed of a typical 2-pole motor
139	206Fh	11	Boost Value	U16	0	Drive Rating Dependent	1dp, e.g. 100 = 10.0%
140	2070h	12	Control mode	U16	0	9	See parameter description for details
141	2071h	13	Application Mode	U16	0	2	0: Industrial Mode 1: Pump Mode 2: Fan Mode
142	2072h	14	Access code	U16	0	9999	No Scaling
143	2073h	15	Digital input function	U16	0	17	See parameter description for details
144	2074h	16	Analog input format	U16	0	7	0: 0…10V 1: b 0…10V 2: 0…20mA 3: t 4…20mA 4: r 4…20mA 5: t 20…4mA 6: r 20…4mA 7: 10…0V
145	2075h	17	Effective switching frequency	U16	0	5 (Drive Rating Dependent)	0 = 4KHz 1 = 8KHz 2 = 12Khz 3 =16KHz 4 = 24KHz 5 = 32KHz
146	2076h	18	Relay Output Function	U16	0	9	See parameter description for details
147	2077h	19	Digital Threshold	U16	0	1000	100 = 10.0%
148	2078h	20	Preset Speed 1	U16	-P-01	P-01	Internal value (3000 = 50.0Hz)
149	2079h	21	Preset Speed 2	U16	-P-01	P-01	Internal value (3000 = 50.0Hz)
150	207Ah	22	Preset Speed 3	U16	-P-01	P-01	Internal value (3000 = 50.0Hz)
151	207Bh	23	Preset Speed 4	U16	-P-01	P-01	Internal value (3000 = 50.0Hz)
152	207Ch	24	2nd Ramp	U16	0	2500	2dp e.g. 250 = 2.50s
153	207Dh	25	Analog Output Function	U16	0	10	See user guide for function details
154	207Eh	26	Skip Frequency Centre	U16	0	P-01	Internal value (3000 = 50.0Hz)
155	207Fh	27	Skip Frequency Band	U16	0	P-01	Internal value (3000 = 50.0Hz)
156	2080h	28	V/F Adjust Voltage	U16	0	P-07	100 = 100V
157	2081h	29	V/F Adjust Frequency	U16	0	P-09	50 = 50Hz
158	2082h	30	Start Mode Select	WORD	See Below		
159	2083h	31	Keypad restart mode	U16	0	7	See parameter description for details
160	2084h	32	DC Injection	WORD	See Below		
161	2085h	33	Spin Start Enable	U16	0	2	See parameter description for details
162	2086h	34	Brake circuit enable	U16	0	4	See parameter description for details
163	2087h	35	Analog Input / Slave Scaling	U16	0	20000	1000 = 100.0%
164	2088h	36	Communication Settings	WORD	See Below		
165	2089h	37	Access code definition	U16	0	9999	
166	208Ah	38	Parameter lock	U16	0	1	See parameter description for details
167	208Bh	39	Analog input offset	U16	-5000	5000	1dp, e.g. 300=30.0%
168	208Ch	40	Display Scaling Function	WORD	See Below		
169	208Dh	41	User PI P gain	U16	1	300	1dp, e.g. 10 = 1.0
170	208Eh	42	User PI I time constant	U16	0	300	1dp, e.g. 10 = 1.0s
171	208Fh	43	User PI mode select	U16	0	1	See parameter description for details
172	2090h	44	User PI reference select	U16	0	1	See parameter description for details
173	2091h	45	User PI digital reference	U16	0	1000	1dp, e.g. 100 =10.0%
174	2092h	46	User PI feedback select	U16	0	3	See parameter description for details
175	2093h	47	Analog Input 2 Format	U16	0	6	0: 0...10V 1: 0...20mA 2: t 4...20mA 3: r 4...20mA 4: t 20...4mA 5: r 20...4mA 6: Ptc-th
176	2094h	48	Standby Mode Timer	U16	0	250	3dp, e.g. 25000 = 25.0s
177	2095h	49	PI Wake Up Error Level	U16	0	1000	1dp, e.g. 50 = 5.0%
178	2096h	50	User Relay Output Hysteresis	U16	0	1000	1dp e.g. 100 = 10.0%

Modbus RTU Register	CAN Open Index	Par.	Description	Format	Min	Max	Data format / scaling
179	2097h	51	Motor Control Mode	U16	0	4	See parameter description for details
180	2098h	52	Motor Parameter Autotune	U16	0	1	
181	2099h	53	Vector Mode Gain	U16	0	2000	1dp, e.g. 500 = 50.0%
182	209Ah	54	Maximum Current Limit	U16	0	1750	1dp, e.g. 1000 = 100.0%
183	209Bh	55	Motor Stator Resistance	U16	0	65535	2dp, e.g. 100 = 1.00R
184	209Ch	56	Motor Stator d-axis Inductance (Lsd)	U16	0	65535	1dp, e.g. 1000 = 100.0mH
185	209Dh	57	Motor Stator q-axis Inductance (Lsq)	U16	0	65535	1dp, e.g. 1000 = 100.0mH
186	209Eh	58	DC Injection Speed	U16	0	P-01	3000 = 50.0Hz
187	209Fh	59	DC Injection Current	U16	0	1000	1dp, e.g. 100 = 10.0%
188	20A0h	60	Motor Overload Configuration	U16	0	4	See Below

9.3.7. Additional Information

Drive Control Word Format

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
High byte								Low byte							

Bit 0: Run/Stop command: Set to 1 to enable the drive. Set to 0 to stop the drive.

Bit 1: Fast stop request. Set to 1 to enable drive to stop with 2nd deceleration ramp.

Bit 2: Reset request. Set to 1 in order to reset the drive if drive is under trip condition.

User must clear this bit when drive is under normal condition to prevent un-expected reset.

Bit 3: Coast stop request. Set to 1 to issue a coast stop command.

For normal operation, Bit 3 has the highest priority, bit 0 has the lowest priority (bit 3>bit 1>bit 0). For example, if user set command as 0x0009, drive will do a coast stop rather than run. For normal run/start, just set this register to 1.

Note that stat/stop (bit 0), fast stop (bit 1) and coast stop (bit 3) only works if P-31= 0 or 1. Otherwise, start/stop function is controlled by drive control terminals. Reset function (bit 2) works all the time as long as drive is operated under Modbus control mode (P-12=3 or 4).

Speed Reference Format (Standard resolution)

Speed reference value is transferred with one decimal place (200 = 20.0Hz). The maximum speed reference value is limited by P-01. Either register 2 or register 5 can be used for speed reference control, however only one reference should be used in any control system, otherwise unexpected behaviour can result.

Acceleration / Deceleration Ramp Time

Active only when P-12 = 4, this register specifies the drive acceleration and deceleration ramp time. The same value is applied simultaneously to the acceleration and deceleration ramp times. The value has two decimal places, e.g. 500 = 5.00 seconds.

High Resolution Speed Reference

This register allows the user to set the speed reference value in the internal format, e.g. 3000 = 50.0Hz. This allows control resolution to 1 RPM with a 2-pole motor. The maximum allowed value is limited by P-01.

Either register 2 or register 5 can be used for speed reference control, however only one reference should be used in any control system, otherwise unexpected behaviour can result.

Drive status and error code Word

High byte gives drive error code. (Valid when the drive is tripped, see 0 for further details)

Low byte gives drive status information as follows: -

- Bit 0: 0 =Drive Stopped, 1 = Drive Running
- Bit 1: 0 = OK, 1 = Drive Tripped
- Bit 5: 0 = OK, 1 = In Standby Mode
- Bit 6: 0 = Not Ready, 1 = Drive Ready to Run (not tripped, hardware enabled and no mains loss condition)

Scope Channel Data Values

These registers show the scope present data sample value for the first two scope channels. The channel data source selection is carried out through Optitools Studio.

Modbus RTU Registers 25 - 28: Drive Serial Number

The drive serial number may be read using these four registers. The serial number has 11 digits, stored as follows: -

Register 28		Register 27				Register 26		Register 25		
x	x	x	x	x	x	x	x	x	x	x

e.g.

Register 25	1										
Register 26	1										
Register 27	8745										
Register 28	57										
Drive Serial Number	5	7	8	7	4	5	0	1	0	0	1

Start Mode, Auto Restart & Fire Mode Configuration (P-30)

This parameter contains 3 values, stored as follows: -

High Byte								Low Byte							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Input Type 0: Constant 1: Momentary Start				Input Sense 0: Normally Closed (Open Fire Mode) 1: Normally Open (Closed Fire Mode)				Start Mode / Auto Restart as: - 0: Edge-r 1: Auto-0 2: Auto-1 3: Auto-2 4: Auto-3 5: Auto-4 6: Auto-5							

DC Injection Configuration (P-32)

The parameter value is stored as a combined 16-bit word which is constructed as follows: -

High Byte								Low Byte							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DC Injection Mode 0: DC Injection on Start 1: DC Injection on Stop 2: DC Injection on Start & Stop								DC Injection Duration: 1dp, e.g. 0 – 250 = 0.0 – 25.0s							

Communications Configuration (P-36)

This Register entry contains multiple data entries, as follows: -

High Byte								Low Byte							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Trip Configuration				Baud Rate				Drive Address							

Data values can be interpreted as follows: -

Drive Address	1 to 63		
Baud Rate	**Setting**	**Modbus RTU**	**CAN**
	0	115k2	500
	1	115k2	500
	2	9k6	500
	3	19k2	500
	4	38k4	500
	5	57k6	500
	6	115k2	500
	7	115k2	125
	8	115k2	250
	9	115k2	500
	10	115k2	1000
Trip Time Set-up	0	Comms Loss Trip Disabled	
	1	30ms Watchdog, Trip on Comms Loss	
	2	300ms Watchdog, Trip on Comms Loss	
	3	1000ms Watchdog, Trip on Comms Loss	
	4	3000ms Watchdog, Trip on Comms Loss	
	5	30ms Watchdog, Ramp to Stop on Comms Loss	
	6	300ms Watchdog, Ramp to Stop on Comms Loss	
	7	1000ms Watchdog, Ramp to Stop on Comms Loss	
	8	3000ms Watchdog, Ramp to Stop on Comms Loss	

Display Scaling (P-40)

The parameter value is stored as a combined 16-bit word which is constructed as follows: -

High Byte								Low Byte							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Display Scaling Source 0: Motor Speed 1: Motor Current 2: Analog Input 2 Signal 3: PI Feedback		Display Scaling Factor: 3dp, e.g. 0 – 16000 = 0.000 – 16.000													

Motor Overload Configuration (P-60)

This parameter is stored as follows: -

High Byte								Low Byte							
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Reserved															
I x t Reaction 0: It.trp 1: Current Limit Reduction															
UL Thermal Overload Retention 0: Disabled 1: Enabled															

9.3.8. Modbus RTU Indirect Parameter Access

Read / Write access to all user adjustable parameters is possible by using only two Modbus registers as shown below.

Register 44: Drive parameter index

This index value will be used by register 45 to carry out parameter read and write function. The valid range of this parameter is from 1 to 60 (maximum number of drive user adjustable parameters)

Register 45: Drive parameter value

When reading this register, the value represents the drive parameter value which index is specified by register 44.

When writing to this register, the value will be written to the drive parameter number specified by register 44.

Parameter Read Method

In order to read a parameter, firstly write the parameter number to register 44, then read the value from register 45, e.g. to Read the Value of P-01

- Write 1 to Register 44
- Read the Value of Register 45

Parameter Write Method

Writing parameter values can be achieved by the same method, however, register 45 is used to write the parameter value after the parameter number has been selected using Register 44, e.g. to Write a Value of 60.0Hz to parameter P-01

- Write 1 to Register 44
- Register 45 will return the present value of P-01, which can be Read if required
- Referring to the parameter table shown in 9.3.6, apply any scaling necessary
    - In this case, 60.0Hz = 3600
- Write the scaled value to Register 45. P-01 now changes to 60.0Hz, or an exception code may be returned.

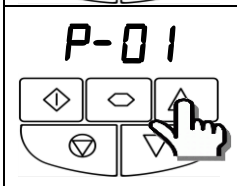
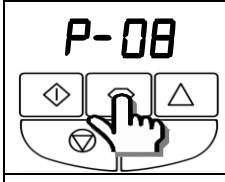
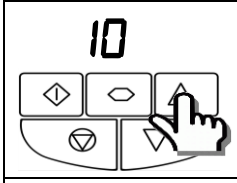
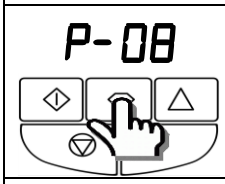
10. Additional Options

10.1. Managing the remote Keypad.

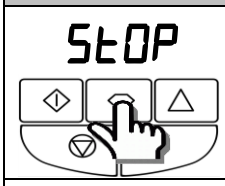
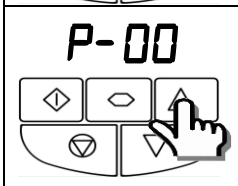
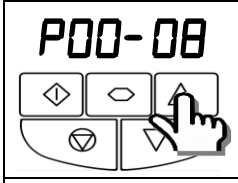
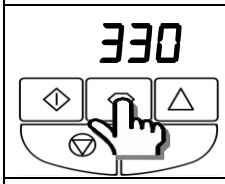
The drive is configured and its operation monitored via the keypad and display.

	NAVIGATE	Used to display real-time information, to access and exit parameter edit mode and to store parameter changes
	UP	Used to increase speed in real-time mode or to increase parameter values in parameter edit mode
	DOWN	Used to decrease speed in real-time mode or to decrease parameter values in parameter edit mode
	RESET / STOP	Used to reset a tripped drive. When in Keypad mode is used to Stop a running drive.
	START	When in keypad mode, used to Start a stopped drive.

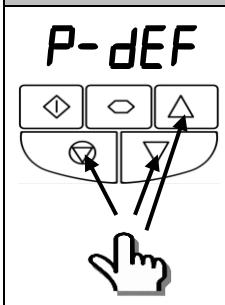
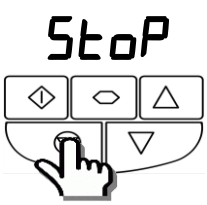
10.2. Changing Parameters

	Press and hold the Navigate key > 2 seconds
	Use the up and down keys to select the required parameter
	Press the Navigate key for < 1 second
	Adjust the value using the Up and Down keys
	Press for < 1 second to return to the parameter menu
	Press for > 2 seconds to return to the operating display

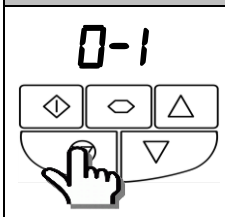
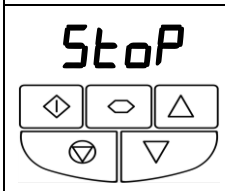
10.3. Read Only Parameter Access

	Press and hold the Navigate key > 2 seconds
	Use the up and down keys to select P-00
	Press the Navigate key for < 1 second
	Use the up and down keys to select the required Read Only parameter
	Press the Navigate key for < 1 second to display the value
	Press and hold the Navigate key > 2 seconds to return to the operating display

10.4. Resetting Parameters

	To reset parameter values to their factory default settings, press and hold Up, Down and Stop buttons for > 2 seconds. The display will show "P-dEF"
	Press the Stop key. The display will show "StoP"

10.5. Resetting a Trip

	Press the Stop key. The display will show "StoP"
	

11. Technical Data

11.1. Environmental

Operational ambient temperature range : -10 … 50°C (frost and condensation free)
Storage ambient temperature range : -40 … 60°C
Maximum altitude : 2000m. Derate above 1000m: 1% / 100m
Maximum humidity : 95%, non-condensing

11.2. Electrical Data

11.2.1. Mains Supply Details	
Supply Voltage Range	110 Volt Units – 110 – 115 Volt +10% / -10% 230 Volt Units – 200 – 240 Volt +10% / -10% 400 Volt Units – 380 – 480 Volt +10% / -10%
Supply Frequency	48 – 62Hz
Inrush Current	< rated input current
Power Up Cycles	>120x /hr, evenly spaced
Single Phase Operation	Three phase drives can be operated from a single-phase supply with 50% derating of the maximum output current
Earth Leakage	When operating from a balanced three phase supply with the permissible supply voltage range, touch current according to IEC61800-5-1 does not exceed 3.5mA.
11.2.2. Motor Control	
Output Frequency Range	0 to 500Hz in 0.1 Hz steps Max Output Frequency = Max Switching Frequency / 16.
Output Voltage Range	0 to Supply Voltage
Speed Regulation	Open Loop < 2% motor rated speed
Torque Control	0 – 175% of rated torque, + / -5% accuracy, Response time <10ms
Effective Switching Frequency	4 – 32kHz
Acceleration Time	0 – 600 seconds, 0.01s resolution
Deceleration Time	Two deceleration ramps 0 – 600 seconds, 0.01s resolution

11.3. Digital & Analog I/O

11.3.1. Digital Inputs Specification

Voltage Range 8 – 30 V dc, Internal or External supply, NPN (positive logic)
Response Time < 8ms

11.3.2. Analog Inputs Specification

Range Current: 0-20mA, 4-20mA. 20mA max input current
Voltage: -10-10V (Analog Input 1 Only), 0-10V, 0-5V, 0/24V, 30V max input
Resolution Analog Input 1: 12-bit, <16ms response time (Uni-Polar)
Analog Input 2: 12-bit, <16ms response time (Uni-Polar)
Accuracy better than 1% of full scale
Scaling & Offset Parameter adjustable
Impedance Current Mode: 500R
Voltage Mode: > 100kR

11.3.3. Analog Output Specification

Range Current: 0...20mA, 4...20mA, 20mA max
Analog: 0...10V, 0 / 24V (digital), 20mA max
Resolution 10-bit
Accuracy better than 1% of full scale

11.3.4. Relay Output

Maximum Switching Voltage : 250VAC, 30 VDC
Maximum Switching Current : 5A at 30 Volt DC, 6A at 250 Volt AC

11.4. Mechanical

11.4.1. Vibration

When mounted, all Compact 2 drive units should not be subjected to vibration levels in excess of the limits defined under EN61800-5-1.

11.5. Response Times

Command Source	Response Time
Digital Input	<8ms
Analog Input	<16ms
Modbus RTU Interface	<8ms from receipt of valid command
CAN Interface	<8ms from receipt of valid command
Master / Slave Function	<8ms, response, 60ms cycle
Power Stage	<10ms to enable output

11.6. Motor Control Performance

11.6.1. V/F Mode

Speed Regulation: + / - 20% of motor slip with slip compensation enabled

11.6.2. Vector Mode

Static Speed Accuracy: + / - 0.033%
Speed Regulation 0 – 100% Load Range: + / - 1%
Torque Response: 1- 8ms
Torque Linearity (10 – 90% of motor rated speed, 20 – 100% load torque range): + / - 5%

11.7. Under / Over Voltage Trip Levels

The following levels are not user adjustable and define the operating voltage levels of the drive and brake chopper circuit.

Drive Rated Supply Voltage	Frame Size	Drive Type	DC Bus Voltage Level (Volts DC)				
			Brake Chopper On	Brake Chopper Off	Under Voltage Trip	Minimum Operating (Inrush Disabled)	Over Voltage Trip
100 – 115 Volts AC	FS1	Voltage Doubler	N/A	N/A	160	239	418
110 – 240 Volts AC	FS1	PFC	N/A	N/A	160	239	418
200 – 240 Volts AC	FS1	All	N/A	N/A	160	239	418
380 – 480 Volts AC	FS1	All	N/A	N/A	320	478	835
380 – 480 Volts AC	FS2	All	780	756	320	478	835

11.8. Automatic Switching Frequency Reduction

The switching frequency selected in P-17 will be automatically reduced based on the heatsink temperature according to the data in section 0

Maximum Permissible Heatsink Temperature. In addition, switching frequency is reduced under the following conditions:

11.8.1. Output Frequency based Effective Switching Frequency Reduction

At low output frequency, Effective Switching Frequency is automatically reduced. Hysteresis is applied to prevent continuous switching. The operation is according to the following table:

P-17	32kHz	24kHz	16kHz	12kHz	8kHz	4kHz
Effective Switching Frequency increases when Output Frequency exceeds	9.0Hz	7.0Hz	5.0Hz	3.0Hz	N/A	N/A
Effective Switching Frequency reduces when Output Frequency reduces below	7.0Hz	5.0Hz	3.0Hz	1.0Hz	N/A	N/A

11.8.2. Output Current Based Effective Switching Frequency Reduction

Effective Switching Frequency is automatically reduced based on motor load current as follows:

- All OPC-2-240095 models:
  - If P-17 = 12kHz, 16 kHz, 24 kHz, Effective switching frequency is reduced to 8 kHz when motor current exceeds 10.45A (110% of the drive rated current). Switching frequency will return to the value set in P-17 when motor current reduces below 7.6A (80% of drive rated current)
  - If P-17 = 32kHz, Effective switching frequency is reduced to 8 kHz when motor current exceeds 10.45A (110% of drive rated current). Switching frequency changes to 24 kHz when motor current reduces below 7.6A (80% of drive rated current). Switching frequency will return to the value set in P-17 when motor current reduces below 6.7A (70% of drive rated current)
- All other models:
  - Effective switching frequency is reduced to 8 kHz when motor current exceeds 140% of the drive rated current. Switching frequency will return to the value set in P-17 when motor current reduces below 110% of drive rated current.

11.9. Electrical Rating Tables

Frame Size	kW	HP	Input Current	Fuse / MCB (Type B)		Maximum Cable Size[1]		Output Current
				Non-UL	UL[2, 3, 4]	mm	AWG	A
110 - 240 (+ / - 10%) V 1 Phase Input, 230 Volt 3 Phase Output (Voltage Doubler) with Integrated PFC								
1B	0.75	1	TBC	16	15	2.5	14	4.3
200 - 240 (+ / - 10%) V 1 Phase Input, 3 Phase Output								
1A	0.37	0.5	TBC	TBC	N/A	2.5	14	TBC
1A	0.75	1	TBC	TBC	N/A	2.5	14	4.3
200 - 240 (+ / - 10%) V 1 Phase Input, 3 Phase Output with Integrated PFC								
1B	1.5	2	8.3	16	15	2.5	14	TBC
380 - 480 (+ / - 10%) V 3 Phase Input, 3 Phase Output								
1A	0.75	1	3.5	6	6	2.5	14	2.3
1A	1.5	2	5.6	10	10	2.5	14	4.1
2	2.2	3	TBC	10	10	2.5	14	5.8
2	4	5	TBC	16	15	2.5	14	9.5

Note

1. Cable sizes shown are the maximum possible that may be connected to the drive. Cables should be selected according to local wiring codes or regulations applicable at the point of installation
2. Refer to the UL Online Certification Directory for a list of UL Recognised products, File Number E226333
3. The integral overload protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with applicable local regulations and the National Electrical Code.
4. Fuse type: UL JDDZ Class J
5. Where permitted, equivalent circuit breakers may be used

12. Diagnostic & Status Information

12.1. Status Indication LEDs

Each control module features two status LED's, labelled A1 and A2; these indicate the drive status as follows.

12.1.1. LED A1 indication

This LED has three colours, and indicates the drive status as follows: -

Drive Status	LED Status		
	Green	Red	Yellow
Stop/Inhibit	Slow flashing	Off	On if fire mode active
Running	Constant On	Off	On if fire mode active Slow flashing if overload
Standby	Constant On	Off	Blink every 3s
Trip / Fault	Off	Constant On	On if fire mode active
Base & Control Module not compatible	Off	Blink every 3s	Off
Internal Commas Loss	Off	Red and yellow slow alternate flashing	
Control Module to base communication link fault	Off	Slow flashing	Off
External 24V	Green and yellow slow flashing at same time	Off	Green and Yellow slow flashing at same time
Optistick Transfer Pass	Fast flashing 2s	Off	Off
Optistick Transfer Fail	Off	Fast flashing 2s	Off
Optistick Fail Other[4)]	Off	Off	Fast flashing 2s
Power Upgrade	All three LEDs lights up in order (Green->Yellow->Red->Yellow->…)		
IO Upgrade	All LEDs on with weak light – uncontrolled due to bootloader		

12.1.2. LED A2 Indication

This LED illuminates when the RJ45 communication interface is active.

12.2. Fault Code Messages

In the event of a trip, the following is a list of potential codes. The fault code will be shown on a connected Optipad or Optiport, and the fault no. will be transferred in the high byte of the drive status word when an external serial communication is used.

Fault Code	No.	Description		Fault Code	No.	Description
no-Flt	00	No Fault		dAtA-F	17	Internal memory fault. (IO)
OI-b	01	Brake channel over current		4-20 F	18	4-20mA Signal Lost
OL-br	02	Brake resistor overload		dAtA-E	19	Internal memory fault. (DSP)
O-I	03	Instantaneous over current		U-dEF	20	User Default Parameters Loaded
I.t-trp	04	Motor Thermal Overload (I2t)		F-Ptc	21	Motor PTC thermistor trip
O-Volt	06	Over voltage on DC bus		FAN-F	22	Cooling Fan Fault
U-Volt	07	Under voltage on DC bus		O-hEAt	23	Environmental temperature too high
O-t	08	Heatsink over temperature		Out-F	26	Drive output fault
U-t	09	Under temperature		Out-Ph	49	Output (Motor) phase loss
P-dEF	10	Factory Default parameters have been loaded		SC-F01	50	Modbus comms loss fault
E-trip	11	External trip		SC-F02	51	CAN comms loss trip
SC-ObS	12	Optibus comms loss		AtF-01	40	Measured motor stator resistance varies between phases.
FLt-dc	13	DC bus ripple too high		AtF-02	41	Measured motor stator resistance is too large.
P-LOSS	14	Input phase loss trip		AtF-03	42	Measured motor inductance is too low.
h O-I	15	Instantaneous over current on drive output.		AtF-04	43	Measured motor inductance is too large.
th-Flt	16	Faulty thermistor on heatsink.		Out-Ph	44	Output (motor) phase missing

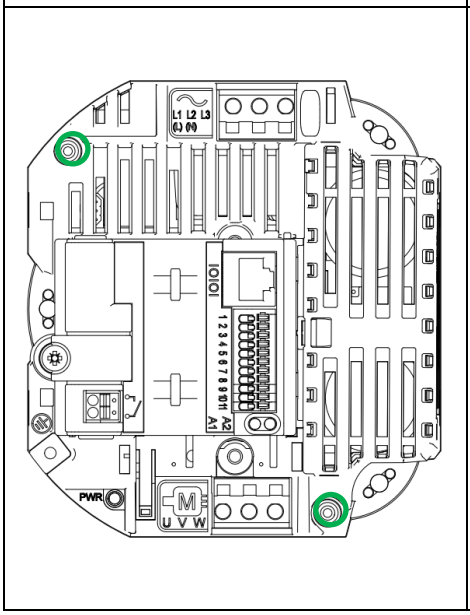
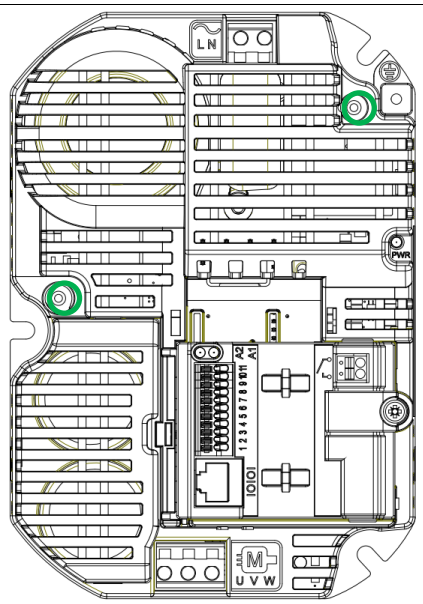
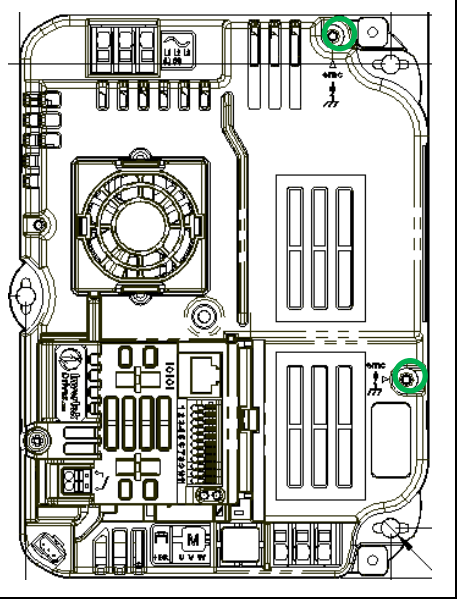
12.3. Circuit Protection Devices

Warning! The opening of the branch circuit protection device, e.g. fuses or circuit breaker may be an indication that a fault has been interrupted. To reduce the risk of fire or electric shock, current carrying parts and other components of the controller should be examined and replaced if damaged. If burnout of the current element of an overload relay occurs, the complete overload relay must be replaced.

13. Appendices

13.1. Appendix A – Disconnecting the EMC Filter

Remove the screws highlighted below.

Frame Size 1A and 1B	Frame Size 1C	Frame Size 2
		

14. Revision History

Issue	Note	Section	Date
01	Pre-Release		05/01/16
02	Firmware version number added	-	15/11/16
	Revision number updated	-	
	Changed description of mounting surface	4.1	
	Revised power module part numbers	3.3	
	Added PFC unit mounting and dimensions	4.2.2	
	Added section relating to operating with Hz / RPM	7.3.1	
	Ambient temperature limit raised to 50ºC	11.1	
	Overload operating times corrected, further detail added	3.6.1	
	Added PFC Rating data	11.9	
	Added fuse ratings		
03	Added 110 Volt Voltage Doubler with PFC Unit	11.9	7/12/16
	Corrected depth measurement of frame size 1B PFC unit	3.3	
	Added units to heatsink data table	4.6	
	Add note for support of Modbus command 16	9.2	
04	Added 110V PFC Model	3.3.2	13/2/17
	Added 230V 2.3 & 4.3A versions	3.3.1	
	Corrected Modbus terminal connections	6.1	
05	Additional model codes added	3.3	27/3/17
	Further information for heatsink calculation added	4.4	
	Revised data for DC Bus voltage levels	11.7	
	Added technical data for further models	11.9	
	Additional notes added relating to UL approved products and fusing	11.9	
	Removed old overload section to avoid duplication of information		
	Added heatsink temperature switching frequency reduction thresholds	11.8	
06	Added additional power module model codes	3.3	21/8/17
	Added further heatsink calculation information	4.4	
	Added additional fault diagnosis info for status LEDs	12.1	
	Added Mounting Torque	4.2	
07	Added additional available model codes	3.3.1	19/2/18
	Improved model code guide	3.2	
	Added Frame Size 2 Mounting Dimensions	4.2.3	
	Revised heat loss data based on latest testing	4.6.4	
	Separate section for EMC disconnect location	13.1	
	P-05 description updated to match latest firmware	7.4.1	
	Improved P-36 description	7.4.2	
	P-48 Standby time maximum setting increased	7.4.2	
	Added notes to digital input function operation to further explain functions	8.3	
	Added option 18 to I/O tables	8.3	
	Removed non-supported codes from fault code table	12.2	
08	Corrected over temperature trip table	0	03/07/18
	Resolution of Modbus registers for P-03 and P-04 corrected	9.3.6	
	Revised switching frequency reduction temperatures	0	
	Corrected firmware version reference to latest firmware	1.1	
	Added information regarding other methods for switching frequency reduction	11.8	
	Corrected Size 2 Model Codes	3.3.1	
	Corrected Modbus connection pins on diagram	5.1	
	Updated statements regarding changing comms parameters through Modbus	9.2	
	Changed 110VD variant to 3.3A	3.3.1	
	Added statement for frame Size 1A / 1B selection	4.2.1	30/10/18
	Standby consumption added	4.4	
	Additional models power loss data added	4.4	09/01/19
	Added note regarding other versions available	3.1	
	Updated model code definition guide to cover all versions	3.2	6/11/19
	Updated available model tables	3.3	
	Added overload and peak current tables	3.5	
	Added overload graphs & combined overload info	3.6.4	
	Added PFC depth	4.2.2	
	Added note not to remove or fit module with power applied	4.3	
	Added 80C max rating for Frame 1B 7.0A	4.5	
	Updated energy efficiency and heatsink requirements	4.6	
	Changesd to V2.05	1.1	